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Railways, City Transit, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewerage and Municipal, Electrical, Contracting, Proposals Open, Manufacturing and Technical.

THE ATLANTIC RECORD has again been broken by a White Star steamship, the *Teutonic*, which arrived in New York on Aug. 19, in 5 days 16 hours and 31 minutes from Queenstown. This beats all previous records, not only by 1 hour and 37 minutes in the voyage itself, as made by the *Majestic*, but by 2 knots in the most knots for one day, as is shown in the following table:

	City of Paris.	*Majestic.*	*Teutonic.*
1st day	462	470	460
2d "	493	501	496
3d "	502	497	505
4th "	506	501	510
5th "	509	491	517
6th "	316	317	290
	2,788	2,777	2,778

The *City of Paris* had made the previous best day's run of 515 knots. The *Majestic* in her famous run of several weeks ago averaged 78 turns per minute for her screws and developed 19,500 HP. The *Teutonic* reached almost 81 turns and developed 19,900 HP. during the best runs. In 1886 the run from Queenstown was reduced to 8 days 2 hours and 48 minutes, by the *Scotia*, 6 days 18 hours 37 minutes, by the *Alaska* in 1882, and from the 5 days 19 hours 18 minutes of the *City of Paris*, in 1889, to the last records of the *Majestic* and *Teutonic*.

THREE NEW ATLANTIC GREYHOUNDS are to be built for the Cunard line by a Clyde ship-building firm, and are expected to easily beat anything which the fast boats of the Inman and White Star lines have yet accomplished. The new vessels are to have a sustained sea speed of 22 knots per hour, which if attained and maintained, will carry them over the course on which the *City of Paris*, *Majestic* and *Teutonic* have made their records, in about 5 days, 7 hours.

THE COST OF OPERATING THE ELECTRIC CARS on the West End Street Railway in Boston averaged 20.37 cts. per car mile during the month of June. The operating expenses of the horse cars operated by the company during the same time averaged 24.58 cts. per car mile. A still greater difference was shown in the earnings, which averaged 42.71 cts. per mile for electric cars, and 36.85 cts. per mile for the horse cars. This left net earnings per car mile of 22.34 cts. for the electric cars, and 12.27 cts. for the horse cars. The total mileage of electric cars during the month was 380,568 miles; and the total horse car mileage was 1,073,217 miles. For the three months ending June 30, the percentage of operating expenses to gross earnings was 56.23% for the horse cars, and 72.7% for the electric cars. In our editorial columns we have compared the earnings and expenses above with those of passenger trains on ordinary railways.

WORK ON THE HUDSON RIVER TUNNEL was suspended about one month ago, owing to a lack of funds and the stringency in the London money market. About $650,000 is needed to complete the river tunnel. In regard to the rumors of cracks in the iron lining and settlement of the tunnel, Superintendent MOIR says: That the cracks have been characterized by Sir BENJAMIN BAKER, the consulting engineer, as of little or no importance, and that the cracked plates can be readily replaced if deemed necessary. The tar covering on the plates will prevent rusting, and the settlement spoken of was foreseen and allowed for in the plans.

THE ST. CLAIR TUNNEL was inspected by Sir HENRY TYLER, President of the Grand Trunk Ry., on Aug. 7. The tunnel is ready for traffic, and the approaches are nearly ready, the work now in progress being excavation on the slopes of the cutting to flatten them and avoid possible slides in the treacherous clay. Extensive sidings have been laid down at each end of the tunnel, and traffic through it is expected to begin very soon. The actual driving of the tunnel was completed a year ago, and the long delay in opening it for traffic seems to be due to the fact that it was not deemed best to spend money on the approaches until the success of the tunnel was assured. The official opening of the is tunnel announced for Sept. 16 next. The principal authorities of the United States and Canada are invited to be present at that time.

PROGRESS ON THE NICARAGUA CANAL, to July 10, stands about as follows: The dredges *City of New York* and *City of Paris* are steadily at work in the canal, advancing at an average rate of 25 ft. per day, each cutting a path 150 ft. wide and 17 ft. below the water surface, or through 24 ft. of sand. The channel across the bar is easily maintained at 12 ft. plus. The railway has not yet reached the divide rock-cutting, so that rock can be obtained for the breakwater, but it is advancing in that direction steadily. There is good weather, little rain, and the health of all is excellent.

THE PLANT USED ON THE MANCHESTER CANAL, according to a paper read by Mr. E. LEADER WILLIAMS, Engineer-in-Chief of that work, before the Institution of Mechanical Engineers, was as follows: 97 steam excavators, and 8 steam dredgers; 173 locomotives and 6,300 trucks and cars; 228 miles of single track railway, costing about $3,150 per mile; 124 steam cranes, 192 portable and other steam engines, and 212 steam pumps of all sizes. The maximum laboring force at any one time was 17,000 men and boys and 200 horses. The coal consumed amounted to 10,000 tons per month. The total excavation was about 46,500,000 cu. yds., including 10,000,000 cu. yds. of sandstone rock.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision Aug. 15 at Egg Harbor, N. J., on the Philadelphia & Reading R. R. line from Philadelphia, Pa., to Atlantic City, N. J. A northbound freight train was being run onto the southbound track to let a northbound passenger train pass, when a southbound express train came up and ran into the freight cars. The engine of the express was overturned and wrecked, the smoking car and first passenger car were piled up on the tender, the second passenger car was overturned and the third remained upright. The first passenger car was almost over the wrecked engine, and several persons were badly scalded. Strange to say, nobody was killed, but 18 were injured, some very seriously. The accident is attributed to the failure of the air brakes on the passenger train, which had already caused the train to run past a station; but the leading cause appears to have been the operating mistake of using as a side track a main track without signal protection and upon which an express was due. We have referred to this accident editorially. A misplaced switch near Barnegat, N. Y., on the New York Central & Hudson River R. R., turned a southbound express into a side track Aug. 13. The driver applied the brakes, but the engine collided with some stone cars and went into the river, followed by the tender. The baggage car was damaged, but the sudden application of the brakes prevented a serious accident. Nobody was hurt. Another accident occurred on the same road at Spuyten Duyvil, near New York, Aug. 19. A local train, 10 minutes late, was backing onto the southbound track to return to New York, although a southbound express was due, but it is said the driver mistook the signal for the express train to be his signal. The local engine was struck a glancing blow by the express and the cars of the latter had several of the steps broken off.

A STONE BRIDGE at Port au Prince, Hayti, was undermined by a flood Aug. 14, and gave way when a number of persons were upon it. Several persons were killed and injured.

THE BERNE RAILWAY ACCIDENT, of Aug. 16, following so closely on the Moenchenstein accident of June 16 on the same line, is likely to detract from the popularity of the Jura-Simplon Railway as a route of travel. The last was due to another excursion train, which was run into by the Paris express while being switched into a siding. The first reports charge gross carelessness in those in charge of the line for not warning the express train of the presence of the "special." The guard's van and the rear car of the excursion train were crushed, and 13 persons killed, and about 48 more or less seriously hurt. The engineer of the express train saw the other train in time to put on his brakes, and thus doubtless many escaped death.

AN EPIDEMIC OF STREET RAILWAY COLLISIONS is prevailing in Pittsburg. In a single week we find the following reported in that city's newspapers: Aug. 7—Fifth Ave. cable car, near Smithfield St., struck fruit vender's wagon, knocking down horse. Same date, Pittsburg & Birmingham Traction Co.'s electric car No. 30 struck and wrecked a hearse which was trying to get out of the way of a car coming in the opposite direction. Aug. 8.—Passenger fell from P. & B. T. Co.'s car No. 12 and was badly injured. Same date, same company's car 24, near South Fifth St., knocked down a team of horses attached to wagon. Aug. 10.—Penn Ave. cable car struck ice wagon which was turning out of the way of another car; line blocked for an hour. Aug. 11.—Collision at grade crossing, Fifth Ave. and Grant St., between Fifth Ave. cable car and Duquesne electric car; cause, a defective brake on the cable car. Three other accidents during the same week, for which we have not the exact dates, occurred on the P. & B. T. Co.'s electric line. In two of these a wagon was struck by a car, and in the third there was a grade crossing collision with another street car.

THE OBLIGATION TO AWARD CONTRACTS TO THE LOWEST BIDDER is the subject of a recent decision by the Supreme Court of Pennsylvania. The officials of a city advertised for proposals for constructing a certain public work, inserting the usual clause: "The right is reserved to accept or reject any and all bids as the best interests of the city may demand." All the bids received were rejected; but the lowest bidder sued for the contract, claiming that under the statute which requires contracts for public work to be awarded "to the lowest responsible bidder," he was entitled to the work. It was argued on behalf of the city that the advertisement was not an absolute and final call for proposals, such as the statute contemplates, but a provisional call, conditioned upon the decision of the proper authorities that the bids received were such as the best interests of the city demanded. The Supreme Court upheld this rather strained construction of the law and decided that the city officials had a right to reject all the bids.

THE DELAWARE BREAKWATER dates from 1822, and while it has not outlived its usefulness, the demand for shelter in that part of Delaware Bay is greater than the breakwater can meet. Maj. RAYMOND, U. S. Engineers, and in charge of that portion of our coast, is now locating a new breakwater. The original structure cost over $2,500,000. During the last nine months vessels carrying a combined cargo valued at $20,000,000 have found shelter there or have there waited for orders.

New Signaling Arrangements for the Fourth Avenue Tunnel, New York City.

The Fourth Avenue tunnel forms the approach to the Grand Central Station, and it was in this tunnel that the serious collision occurred on Feb. 20, details of which were given in ENGINEERING NEWS, Feb. 28, March 7, and April 4, while the gong signal was described and illustrated in our issue of Feb. 28. The four-track line, over which the trains of the New York Central & Hudson River R. R., New York, New Haven & Hartford R. R., and New York & Harlem R. R., reach the Grand Central Station, and upon which the tunnel is situated, is known as the Harlem Line, and, with the station, is under the control of Mr. C. H. PLATT, General Manager, the jurisdiction of the officers of the several lines commencing at the junctions of these lines with the Harlem line. The collision above referred to led to a thorough investigation of the signaling plant, with a view to securing increased safety in the operation of the heavy traffic. A plan was formulated, and general specifications of the requirements were prepared by Mr. PLATT, and the contract for the work has been let to the Johnson Railroad Signal Co., of Rahway, N. J. Experiments are also being made with methods for improving the ventilation of the tunnel.

The general system is the Sykes, combined with full track circuits, and added to this are, *First*, Scott indicators, which show to the operator in each tower whether the blocks or sections controlled by him are clear or occupied, the indicator circuits being interlocked with the Sykes plunger; and, *Second*, audible signals, both torpedo and gong, working in harmony with the usual home signals. All visual signals are in duplicate, one on either side of each track, and work simultaneously. While it is believed by the officers of the road that the system as now arranged is one of the safest in use in this country or any other, an effort has been made to provide additional safeguards, and also to provide for the occasional failure of the electric current through the Sykes circuit and the track, to perform its part in unlocking the signal levers. The latter provision is especially important, inasmuch as it is more difficult to maintain a perfect track circuit through a tunnel than elsewhere; and from the further fact that with a movement of about 500 separate trains and engines over the line per day, even the occasional failure of the track circuit may cause serious delays. There will be two sets of towers, one for northbound and the other for southbound trains, and each tower will be equipped with a Johnson interlocking machine and improved block instruments.

The specifications and requirements for the new system, briefly stated, are as follows:

1. All safeguards and indicators now in use, in connection with the Sykes cabinets, or otherwise, to be retained and to work in harmony with the improved system.

2. The blocks or sections to extend 100 ft. beyond each home signal, and to be so arranged that it shall be impossible to clear the signals in the rear of the section until a train once admitted has passed entirely out.

3. New cabinets and locks to be so arranged that gravity must be overcome to unlock the levers, instead of allowing gravity to assist in unlocking, as in the present cabinets.

4. An independent and direct circuit, together with supplemental cabinets, shall be provided to unlock a "caution" lever in the rear tower of each section, to enable the operator there to withdraw the audible signals and show a caution signal in case the regular track circuit is out of order, or inoperative. This secondary or green signal to be used only by the concurrent action of the operators in both towers.

5. Circuits and locks to be so arranged that it shall be impossible for the operators to show a clear signal when section ahead is occupied.

6. It shall be impossible for any operator to show either a clear or caution signal without the permission and co-operation of the operator in the advance tower.

7. It shall be impossible to show the green, or caution signal, until the train preceding, or some part of it, has reached and passed the advance tower.

8. All visual signals to assume the danger position automatically when the train for which they were cleared passes them.

9. All signals to be repeated to the towers controlling them; repeaters to show position of signals visually and to warn audibly if not working properly, or if the light is extinguished.

10. The primary and secondary cabinets and circuits to be so arranged as not to conflict in any way with each other; the use of the secondary circuits not to be a bar to prevent the use of the primary or track circuit for the next train.

11. All signals and mechanical devices to be weighted to the danger position and the whole system so arranged that the failure of any part of it will put and hold the signals at danger.

12. The audible signals not to assume *automatically* the danger position on the passage of an engine or car.

13. The visual and gong signals to be so arranged that they can be put to danger at any time—during the passage of a train if necessary.

14. Torpedo exploders to be so connected that they cannot be restored to danger during the passage of a train, but can be at all other times. This is to prevent operators from throwing a torpedo exploder to danger before the last truck has passed, thereby exploding the torpedo and leaving the chamber empty during the approach of the following train.

15. Audible signals, both torpedo and gong, to work in harmony with the visual signals, except as above provided.

16. Movements of signals, detector bars, etc., to have the benefit of the full stroke of levers.

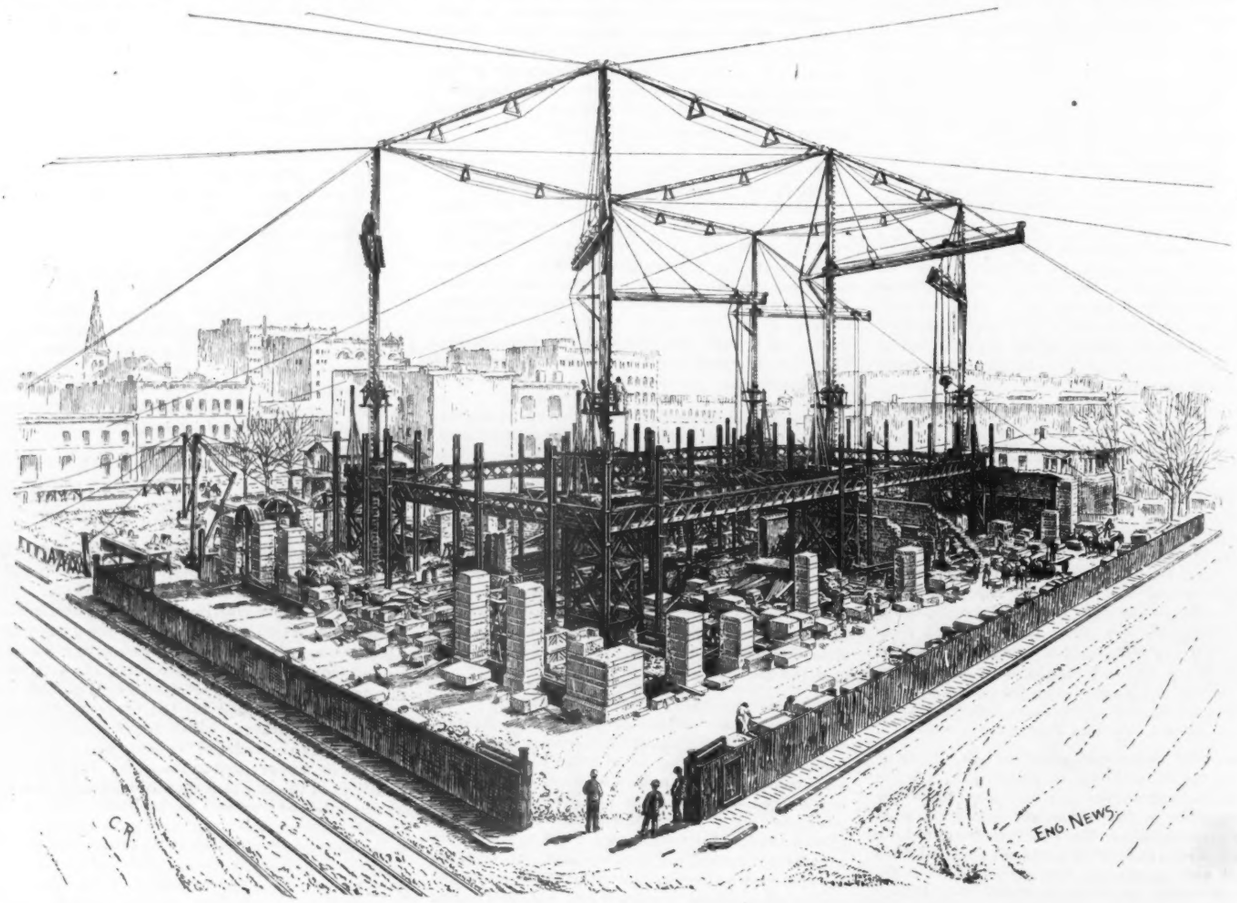

FIG. 1 DERRICK PLANT USED IN THE ERECTION OF THE EQUITABLE BUILDING AT DENVER, COL.

17. Cabinets and locks to be so arranged that the plunger cannot be pushed in when the section is occupied.

18. Cabinets to be of durable parts, strongly made, simple in plan and so arranged that the plunger contact shall be full and complete at each stroke.

The other requirements pertain only to the mechanical construction and need not be enumerated here. All the other problems raised by these specifications are said to have been successfully met, and without complicated currents and mechanism.

The Broadway Cable Road, New York.

(WITH INSET.)

The cable railway now being put down on Broadway, New York, is doubtless being built in the face of greater local obstruction from water and gas pipes, electric conduits, rock formation, etc., than any similar road in this country. In our inset we give the general type of construction, including the details of the erection of the concrete backing to the cable tube. We may say at the outset that out of the entire length of 5.17 miles of the road, extending from the Battery to Fifty-ninth St., somewhat over two miles are completed, and the work is progressing at the rate of about six short city blocks per week. The contractor, Mr. JOHN D. CRIMMINS, estimates that the entire line will be completed before Jan. 1, 1892. But as power-houses have to be built at Houston and Fifty-first Sts., the line will not be in operation before some time next spring. It is the intention of the company, to ultimately cover and surround the power stations with offices, warehouses or stores, though this will follow later.

The original intention of Mr. GEORGE MCNULTY, the engineer of the road, was, we understand, to use a system of subway for the disposal of the underground fixtures, whereby a permanent street surface would be supported by girders and posts and an open space left below for the disposal of pipes, etc., and ready access afforded to the same. For certain reasons this plan was abandoned for one which removes the obstructing material from the line of the cable conduit here shown. What this meant in delay, expense and careful handling of the buried plant can only be fully appreciated by a personal inspection of the work. In the first place there were practically no reliable records of the number, position and depths of the underground pipes; they had been put in at various times and under various authorities, and in such position as previous occupation would permit.

Included in this tangle under Broadway, and lapping over and intersecting each other through the centre of the street, were the mains and branches of the Croton water system, the mains and branches of seven gas companies, the main cables of the Western Union Telegraph Co., and of the telephone, electric light and steam heating companies, the subway, and, from Twenty-third to Dey St., the pneumatic conduit of the Western Union Company. Some of the water pipes were laid 30 years ago, and they cross the street, practically, from curb to curb in places. Some of the gas mains were almost as old and irregular in location, both being put down when the streets were empty and order in their laying not appreciated. At and above Broadway and Thirty-fourth St. the native rock came up to the base of the paving blocks, and the excavation of new trenches and the shifting of old pipes necessitated the use of steam drills and dynamite. And as the old pneumatic conduit, from Twenty-third to Dey St., was under the middle of the street and would have been covered by the solid concrete floor of the cable system, the former had to be rebuilt in its entire length on one side of the street. When it is considered that all these obstructions had to be removed, and the new system built without practically interfering with the traffic on the busiest street in America, the work of both the engineer and the contractor can be better appreciated.

The general method of operation was about as follows: First of all, a most careful and systematic survey was made of the material under the street by borings and by wells dug, and in this way, by the careful measurements made, it was possible to determine what pipes and systems had to be relaid and where shifting was economically possible. So far, we understand, no material blunder in measurements or delay has occurred; and the pipes have been shut off, cut, and new mains laid and connected with the greatest possible speed. Many of the cross-sections taken by the engineers show marvels of complication; but our readers can form an idea of what these are in some places by an inspection of the tangles shown in our issue of Nov. 1, 1890.

It should be mentioned that the tracks of the old horse-car lines were first transferred to the sides of the street, close to the curbs, in lengths of a few blocks at a time, and the traffic has only been interrupted during the actual construction of the road. Portable foot bridges, placed over the excavations, carried the pedestrian traffic.

Our inset, made from the official plans, is so full in detail that little need be said about it in the way of dimensions and general design. The steel rails are of the grooved girder type, and are 7 ins. high. The rail proper weighs 91 lbs. per yd., and the slot rail weighs 67 lbs. per yd. The McConway & Torley continuous splice used with these rails was illustrated in our issue of July 18, 1891. The cast-iron yokes, spaced 4 ft. 6 in. apart, weigh 550 lbs. each, and the total 4,000 or more necessary will weigh about 1,100 tons. These yokes rest on a concrete bed of the dimensions shown (45 × 6 × 18 ins.), made of one part Portland cement to three of sand and five of broken stone. Connecting these yokes and forming the conduit between them is a U-shaped section of $\frac{3}{16}$-in. steel plate, bolted to the yokes, and around this conduit again is 6 ins. of Portland cement concrete, which latter is extended over the surface to support the paving blocks. The formers, clips and connections used in placing this concrete are shown, and it may be said, for the benefit of some inquirers, that nothing was used to prevent the sticking of the concrete to these plates, nor was such precaution found necessary.

It is understood that when the road is in operation two distinct cables will be carried in the conduit, one of these being held in reserve in case of accident. In operating the road the first cable loop will extend from Houston St. to the Battery and back, or 4.24 miles, and to a sheave-pit between Thirty-sixth and Thirty-seventh Sts. and back, a distance of 3.96 miles. From the power-station at Fifty-first St. a single loop will extend to the Thirty-sixth St. pit and back, a distance of 2.24 miles. Not including station lengths and the second cable, this amounts to 10.44 miles of cable.

The purpose of the engineer and the company has been to make this cable railway perfect and a model in all its detail and appliances. It can be readily understood that under the conditions outlined no fixed bid was possible for the performance of this work. Consequently, we understand, that Mr. CRIMMINS furnishes his force, wide experience and personality at a certain percentage on the absolute cost of construction, a proceeding unusual, but wise in this case. We trust later to give further details as the work progresses.

The Old English Standard Yard.

It has been recently discovered that the standard yard and certain other measures and weights supposed to have been lost in the fire in the Houses of Parliament in 1834 still exist. The following account of these standards is from *Nature:*

A reference to the contemporary records shows that after the fire the standard bars of 1758 and 1760 were both found among the ruins, "but they were too much injured to indicate the measure of a yard which had been marked upon them." The principal injury to both of the standards was the loss of the left-hand gold stud, but whether this was caused by the action of the flames or otherwise is not known. When the Palace of Westminster was rebuilt the bars were deposited in the Journal Office, and from that time until recently they seem to have been wholly lost sight of. Some time ago it happened to be stated in the lobby that one of the duties of the Speaker was to inspect once in every 20 years the standards immured in the sill of the lower waiting hall. Inquiries at the standards department of the Board of Trade elicited the fact that, so far from any statutory requirement being imposed upon the Speaker in the direction indicated, Section 35 of the Weights and Measures Act, 1878, which provides for the care and restoration of the parliamentary copies of the imperial standards, specially exempts the walled-up copy from periodical inspection and comparison It was found, however, that in 1871 Speaker DENISON took cognizance of the standards; and this fact was brought to the Speaker's notice. While inquiries were being made as to Speaker DENISON'S inspection, an official in the Journal Office mentioned that when the contents of that office were recently being transferred to the new wing he had observed among the lumber some old weights and measures. These proved to be the missing standards. They were examined by Mr. CHANEY, the Superintendent of Weights and Measures.

The most important of the standards thus rescued from oblivion are the yard measures constructed by BIRD in 1758 and 1760. The former was copied from a bar in the possession of the Royal Society, which was itself a copy of a standard preserved in the Tower; and the second was constructed under the directions of a committee of the House of Commons from the 1758 standard. "Each of these two standard yards consisted of a solid brass bar 1.05 ins. square in section and 39.73 ins. long. Near each end of the upper surface gold pins or studs 0.1 of an inch in diameter were inserted, and points or dots were marked upon the gold to determine the length of the yard." The other standards in the custody of the Journal Office are two brass rods answering the description of the old exchequer yard, and four weights supposed to be certain of the "copies, model, patterns and multiples," ordered by the House on May 21, 1760, "to be locked up by the clerk and kept by him." The most important weight—the standard troy pound—is not among those now brought to light.

Plant Used in Erecting the Equitable Building at Denver, Colo.

BY A. MCL. HAWKS.

The Equitable Life Assurance Society is erecting in the city of Denver, Col., a large 9-story office building, at an estimated cost of $1,500,000. The building covers a ground space of 200 × 125 ft., light and air being furnished to the interior offices by two courts. The total height of the building above the sidewalk will be 130 ft., and the total weight of material in the structure above the foundations is estimated at not less than 50,000 tons. The two lower stories are to be of Gunnison red granite. The upper stories will be of "Milwaukee" tile brick, with all main division walls of pressed brick.

When the site and the principal architectural features had been decided on, a thorough study of

Fig. 2. Part of Derrick Plant Before Erecting Columns.

methods of erection was made to secure the best plan for hoisting this great weight of material into place with rapidity and safety. The result of the study was the adoption of skeleton derricks of the Norcross type, as shown in Fig. 1. While excavation for the foundations was in progress, plans for the derricks were made by Mr. WM. SCANLAN, Superintendent of Construction, assisted by the Hendey & Meyer Engineering Co. By the time the excavation was done, the derricks were erected ready for work. They formed a skeleton framework, as seen in the engraving, a hundred feet high, and

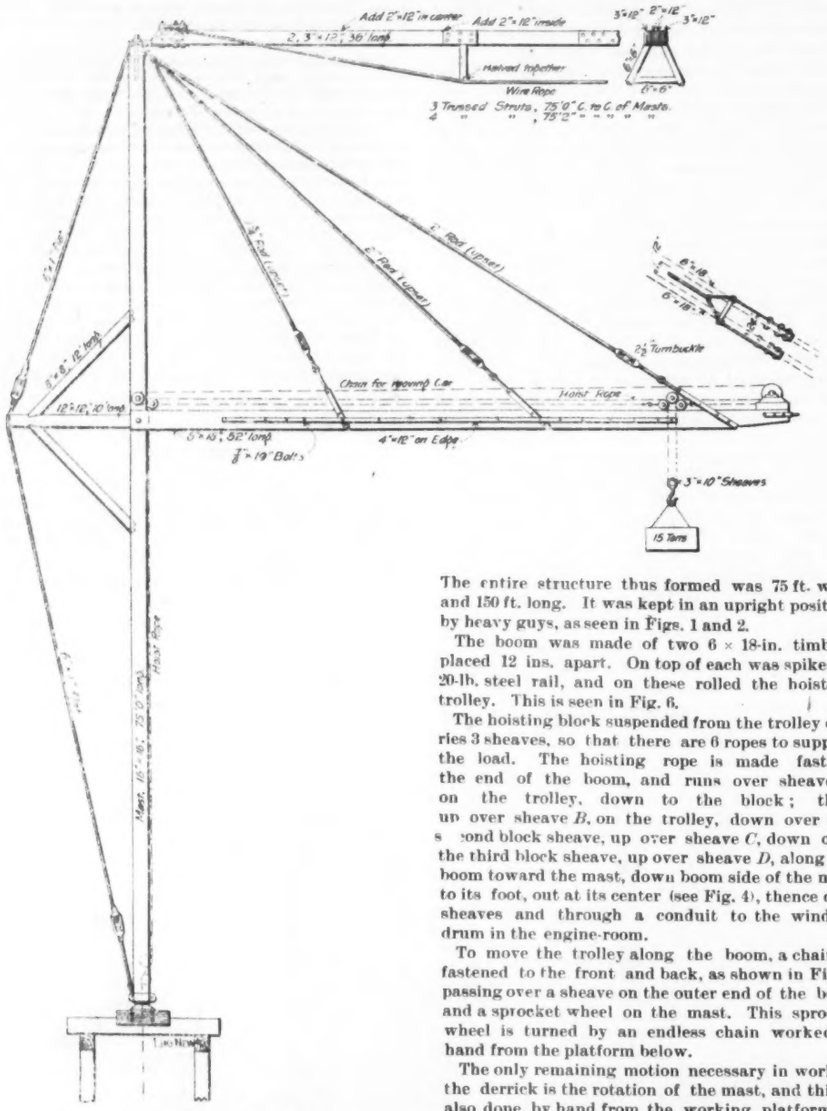

Fig. 4. General View of Mast and Boom.

many and curious were the explanations vouchsafed by the wise ones. One "who knew all about it" explained to a friend that "that frame was to hold the building up while it was being built"

The excavations for the foundations were carried to solid gravel, 20 ft. or more below the street level. The pits were then filled with a mass of concrete, in which wer embedded steel I-beams 7 to 24 ins. deep, crossing each other at right angles. The concrete was 1 ft. thick beneath the bottom of the lower course of beams and was filled in solid in the interstices between the beams.

The masts for the derricks are 16 ins. square, mounted in a heavy shoe at the foot, which turns on a pivot in a cast-iron foundation plate, seen in Fig. 3. At the top a 3-in. pin, 5 ft. long, is fastened in the mast and passes through a hole in a plate bolted to the upper framework. The mast is thus free to rotate. A horizontal boom 52 ft. long is attached to each mast and supported by three guy rods from its top. The thrust of the heel of the boom tending to bend the mast is counteracted by a truss on the opposite side. The guys which support the boom are joined to it by "straddle straps," which have an opening large enough to permit the passage of the hoisting trolley. All these particulars are shown in the general view of the derrick in Fig. 4 and in the details of the connections, Fig. 5.

All these masts are mounted on the top of timber towers about 25 ft. high, and are connected at the top by trussed, built-up timbers 75 ft. in length. The entire structure thus formed was 75 ft. wide and 150 ft. long. It was kept in an upright position by heavy guys, as seen in Figs. 1 and 2.

The boom was made of two 6 × 18-in. timbers placed 12 ins. apart. On top of each was spiked a 20-lb. steel rail, and on these rolled the hoisting trolley. This is seen in Fig. 6.

The hoisting block suspended from the trolley carries 3 sheaves, so that there are 6 ropes to support the load. The hoisting rope is made fast to the end of the boom, and runs over sheave *A* on the trolley, down to the block; then up over sheave *B*, on the trolley, down over the second block sheave, up over sheave *C*, down over the third block sheave, up over sheave *D*, along the boom toward the mast, down boom side of the mast to its foot, out at its center (see Fig. 4), thence over sheaves and through a conduit to the winding drum in the engine-room.

To move the trolley along the boom, a chain is fastened to the front and back, as shown in Fig. 4, passing over a sheave on the outer end of the boom and a sprocket wheel on the mast. This sprocket wheel is turned by an endless chain worked by hand from the platform below.

The only remaining motion necessary in working the derrick is the rotation of the mast, and this is also done by hand from the working platform by the mechanism shown in Fig. 3. The worm gear enables a powerful leverage to be exerted, and the rotation is very easy. The movement of the trolley along the boom is also very easy; even when carrying loads of 10 tons, 2 men on the platform can run it back and forth along the boom.

To control the hoisting, an electric-signal post with 6 signals denoting the various moves and speeds is placed on each platform, and connects with the engine-room. Thus the "warden" on each platform has complete control of every movement of his derrick, and is alone responsible for its rapid and proper handling. This arrangement has proved very satisfactory, and has worked thus far without accident, although one narrow escape occurred, which led to the adoption of mechanism to prevent accidents from the same cause in the future.

The circumstances were as follows: On each cable is painted a spot at such a point that its appearance in the engine-room notifies the engineer that the rope is "chock-a-block." Constant use dims these spots; and though they are supposed to be kept fresh and bright this is sometimes neglected. One day an engineer was signaled to "wind," and no order was given to "stop." The painted spot crept unnoticed into the engine-room and onto the drum; and had not the engineer shut off steam as soon as his machine began to labor, the result would have been a wreck. No harm was done, however, and the following device was at once put on each winding drum. A light rod acts as a shaft for an index finger connected with the spring hammer of a little gong. Along the rod this finger can be adjusted to any position, so the rope will wind on the drum until full up; but if it winds beyond this point, it forces the finger over, strikes the alarm, and warns the engineer that his blocks are "chock-up." While the work is *below* the warden on the platform, the necessity of this audible alarm is not so apparent; but when the work is all being done *above* him, and partly or completely out of his sight, it is quite a necessary safeguard.

As the derricks now stand they will build the lower five stories of the building; then they will be jacked up on the ironwork, and from this elevation the building will be completed.

All the bricks for this building are packed in crates, built like cart bodies, holding 1,200 bricks each, at the side tracks in Church Bros.' brickyard, at Golden, Col. They are transported by rail 15 miles to the sides track in the city, where they are loaded by a derrick onto wagons, which haul them to the building. Here the derricks pick them up and place them on the scaffold (still in the crate) as fast as they are needed. The saving by this crating system, including the cost of transportation of the empty crates back to the brickyard, is estimated at over 8% in the one item of broken and badly chipped brick. There is also a saving of three handlings, each of which is worth 25 cts. per M in labor, besides the not inconsiderable loss of brick due to these handlings.

Standard Tests and Methods of Testing Materials.

In our issue of March 7, 1891, we gave an account of the progress thus far made by the Committee of the American Society of Mechanical Engineers,

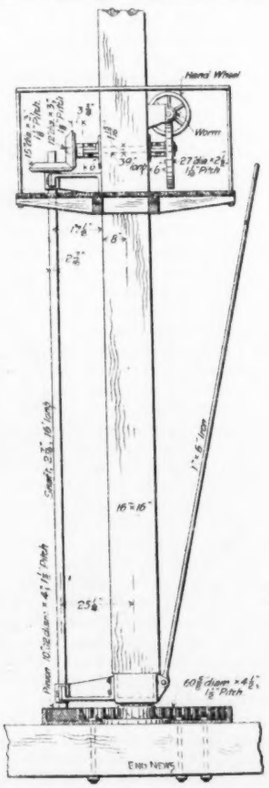

Fig. 3. Detail of Foot of Mast and Mechanism for Rotating it.

which is engaged in formulating a standard code for methods of testing materials. Appendices III. and IV. to their report have just been issued, the first giving a report of the third conference of German, Austrian and Prussian engineers, held at Berlin last September, and the second being a translation of a lecture by Prof. BELELUBSKY, of St. Petersburg, on the effect on percentage of elongation produced by variations in dimensions of the test piece.

We abstract the report of the September Conference's work as follows:

Allowances for the Effect of Time on Tests.—It was agreed to adopt the method of measuring elon-

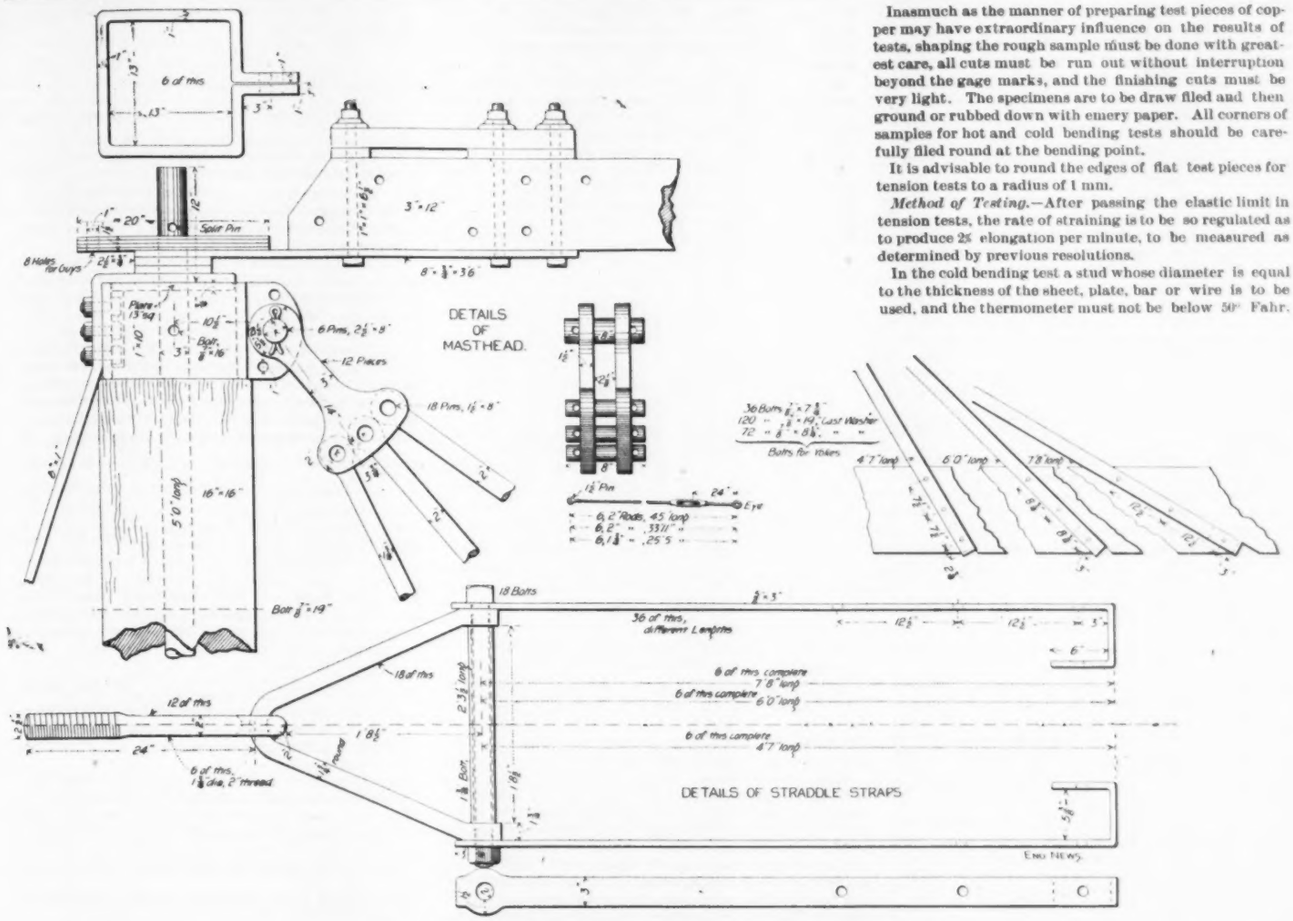

FIG. 5. DETAILS OF MAST HEAD AND BOOM CONNECTIONS.

gation, between two fixed gage marks, excluding those tests in which rupture does not occur within the central third. It was also decided to measure elongation of flat test pieces by the "symmetrical method," dividing the test piece into centimeter lengths on one side and both edges, and recording elongation of the flat side and the average elongation of the two edges separately. The new "Standing Committee" was asked to formulate rules for taking account of the effect of the rate of testing, and statements of the necessary accuracy of testing machines.

Drop-test Apparatus.—It was recommended that the drop be an iron ball weighing 1,000 kilograms, or half that weight in exceptional cases, and means be provided for accurately regulating the weight of drop. More than this it was not thought best to specify at present.

Abrasion Tests.—It was concluded that the results of a single test of abrasion are not a safe guide; also that an abrasion test should imitate as closely as possible the method of wear of the material in actual service. Further action was intrusted to the Standing Committee.

Standard Methods of Testing Copper, Bronze, etc.—The following resolutions were adopted:

1. The importance of the crushing test is generally admitted; but as sufficient data have not, as yet, been obtained, this test is not now recommended, and the matter is referred to a committee.

2. Similarly, the bending test of a threaded piece is not recommended, as this test may be strongly influenced by the manner of execution.

3. The tension test pieces are to be draw-filed and then polished with fine emery paper.

The following was adopted as the standard method of testing copper:

Copper in the form of plates, sheets or bars shall be subjected to a tension test and to a bending test both cold and hot. Copper wire shall be subjected to a tension, bending, and winding or torsional tests.

Condition of Material.—Tests are to be made of the material as delivered, or on plates, sheets or bars if desired in softened condition. In order to determine the qualities of the material in its natural condition, test pieces must be annealed. To do this the strips out of which test pieces are to be shaped are to be subjected, before finishing, to a heat of from 600° to 700° C. (1,112° to 1,292° Fahr.), but not above this, then allowed to cool off to blackness (disappearance of glowing) in the air, and then cooled off in water of a temperature of 15° C. (59° Fahr.)

Selection and Preparation of Test Piece.—Test pieces are always to be sawed out or else filed, or cut from the piece by a machine tool, particular attention to be paid to do as little straightening afterward as possible. When this becomes necessary it must be done with greatest care, and, if possible, by means of wooden or copper mallets. When the material is to be tested after annealing, the test pieces may be straightened hot between roughing and finishing. But in all events they must again be annealed before testing. The standard shape and dimensions heretofore adopted are not changed, though this may be done at a future time, as it is desirable to reduce the size of test pieces of such expensive metals as much as possible.

Inasmuch as the manner of preparing test pieces of copper may have extraordinary influence on the results of tests, shaping the rough sample must be done with greatest care, all cuts must be run out without interruption beyond the gage marks, and the finishing cuts must be very light. The specimens are to be draw filed and then ground or rubbed down with emery paper. All corners of samples for hot and cold bending tests should be carefully filed round at the bending point.

It is advisable to round the edges of flat test pieces for tension tests to a radius of 1 mm.

Method of Testing.—After passing the elastic limit in tension tests, the rate of straining is to be so regulated as to produce 2% elongation per minute, to be measured as determined by previous resolutions.

In the cold bending test a stud whose diameter is equal to the thickness of the sheet, plate, bar or wire is to be used, and the thermometer must not be below 50° Fahr. Test pieces taken from plates, sheets and bars which can be bent around the stud 180° without breaking are to be closed down until the inner surfaces touch. Bending tests of wire are to be made as heretofore prescribed for wires.

Hot bending tests shall be made with samples heated to a cherry red, and be continued until cracks appear or until the inner surfaces touch. Winding or torsional tests are to be made as previously prescribed for wire tests.

In testing metals and alloys (other than iron and steel) for which no standard for tests has been heretofore proposed, the tests to be used should follow those already prescribed for cast iron or for copper, according to the character of the material. To materials resembling cast iron in their physical qualities tension and transverse tests should be applied. For the soft and ductile metals, tension, compression and bending tests, hot and cold, should be made.

Concerning test pieces for cast iron, objections had been raised to the method formerly recommended; and the following was substituted:

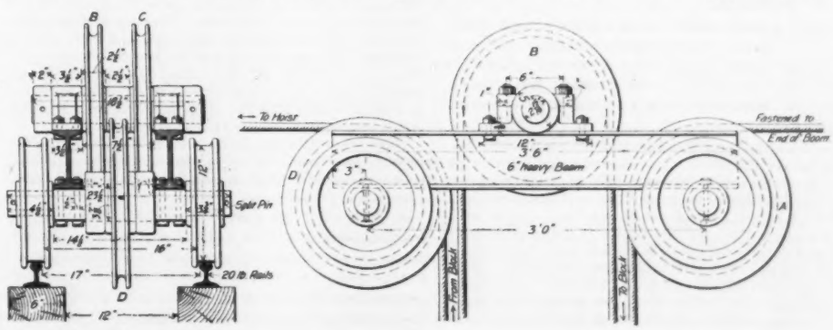

FIG. 6. HOISTING TROLLEY ON DERRICK BOOM.

Test bars are to be cast in a flask slightly inclined, rising about 1 in 10. The pressure under which the bars are cast, as measured by the gate, is to be 20 cm. (7.85 ins.) Test pieces are to be provided at each end with a prolongation 1 in. square, from which in case of necessity 1-in. cubes can be cut for compression tests. Tension test pieces are to be turned down to 18 mm. diameter (0.711 in.).

Porosity of Bricks and Tiles.—The standards adopted were as follows:

The specific gravity shall be obtained by using powder which passes a sieve of 900 meshes per sq. c.m. (5.732 meshes per sq. in.) and from which all dust passing a sieve of 31,170 meshes per sq. in. (4,900 per sq. cm., has been removed. This determination is to be made by means of the volumenometer.

The volumetric weight is to be ascertained by the hydrostatic method, *i. e.*, by measuring the displacement of water by a given volume of material. In cases where losses may be occasioned by solution or absorption of soluble materials, the volumenometer is to be used for measuring the weight of a given volume after the pieces have been coated with paraffine wax.

The absorption of water and the soluble salts contained shall be determined.

The determination of injurious admixtures, as particles of unslaked lime, etc., are to be made in a manner analogous to that used in the case of artificial building stones.

The determination of the superficial absorption, as also of the permeability of tiles, is to be as follows:

Pieces of tiles are selected of such size that they can absorb from 20 to 25 cu. cm. (1.22-1.52 cu. in.) of water. These pieces are dried and edges coated with paraffine wax. Now cylindric pipes of 10 cu. cm. contents are sealed on them by the same material. The following observations are made:

a. The time during which 10 cu. cm. water are absorbed, which are measured into the pipes by means of a pipette.

b. The lapse of time after which dew-like precipitation appears on the lower surface after another 10 to 15 cu. cm. water have been added.

c. The time which elapses until drops may possibly be formed upon the under surface after another 10 cu. cm. water have been added, or else the quantity of water which percolates into a dish below in case of permeability of the tiles.

Transverse strength is to be determined by applying two ridges of Portland cement 1 cm. wide on the under side, 20 cm. between inner edges. Then centrally between their ends on the opposite side another similar ridge is applied. The pressure is applied on the latter ridge and bearing is given on the two others.

Determination of Rate of Setting and Constancy of Volume of Puzzuolana.—A weight is to be used on the needle which will cause complete penetration when the metal is soft, using a box about 4 cm. deep. For determining constancy of volume a metal cylinder slightly tapering toward the bottom, and with a solid base, is to be used. In making the test it is recommended that the metal cylinder be 3 to 4 cm. deep and 6 to 8 cm. in diameter at the top. The mixture is filled into this and struck off level with the top, and the cylinder is then submerged in water. It is desired that all the expansion which takes place shall be upward, which explains the reason for the precautions noted.

Sieves for Obtaining Standard Sands.—It was recommended that sieves made of perforated plates be substituted for those made of wire, as being decidedly preferable.

EFFECT OF THE SHAPE AND SIZE OF THE TEST-PIECE ON ITS ELONGATION.

We give nearly in full the paper by Prof. BELELUBSKY on this topic as translated by Mr. GUS C. HENNING, Reporter to the Committee of the Am. Soc. M. E.

In establishing specifications for mild steel for boilers and ships, the Commission appointed by the Minister of Roads met with considerable difficulty in determining the desired elongation for plates of different thicknesses, for, as is well known, testpieces of the same length and breadth but of different thickness give different elongations, and the investigations heretofore made had not yet determined the laws governing these variations. For this reason, two Russian engineers, BRANDT and LIACHNITZKI, made a series of tests of mild steels in 1887 and 1888. The material was furnished by three steel works; the testpieces used were obtained partly from plates of different thicknesses and partly by planing down strips cut from one plate to obtain the desired shape. All testpieces had the same width and length, as is usually prescribed in specifications; and the problem of the investigation was to discover the relation between elongation and thickness of the testpieces.

Without going further into detail, I wish to say that, according to these tests, elongation diminishes with thickness, as was to be expected, and that it amounted to 24% to 25% in plates of 10 mm. thickness (0.394 in.), and decreased to 13% to 14% in plates of 5 mm. thickness (0.197 in.). These results agree generally with the specifications of the French Navy.

The above-named engineers also took up the problem of comparison of standard shapes of testpieces, using the investigations of BARBA, BENNETT and others, as well as their own, bearing on the relation existing between elongation and dimensions of testpieces.

BARBA'S law* is thus far the only known one, and is as follows: "Testpieces having sections geometrically similar show actual elongations proportional to their dimensions, and equal when stated in per cent." This law is made practical use of in France, where the writer on his visit to the shops of the Paris, Lyons & Mediterranean R.

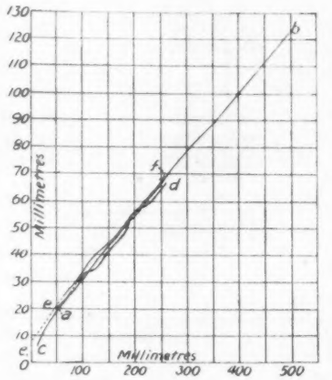

Fig. 1.

R. during the summer of 1889 saw the preparation of testpieces which were geometrically similar.

Although this method makes it possible to prescribe a certain fixed percentage of elongation for all shapes of material, it has several great objections; it is very difficult and inconvenient to adhere to the geometrical similarity of testpieces in a large order of material. For practical purposes it is easiest to maintain a fixed length of testpiece, as is usually done, with a uniform width in the case of flat pieces, prescribing for rounds a fixed series of diameters, as has been done in the "Resolutions of the Conferences of Munich and Dresden."

BARBA'S law undoubtedly points to a greater generalization, and to the inquiry:

1. From a scientific point of view, what relations exist between the elongations of two testpieces whose three dimensions—length, breadth and thickness—vary irrespectively? and,

2. From a practical point of view, what relation exists between the elongations of two testpieces of equal length and different cross-section dimensions?

The formulas deduced by the above-named Russian engineers and given below present a generalization of BARBA'S law to some extent, and permit the determination of the relation of elongation and dimensions of testpieces in some special cases.

Actual total elongation, as is well known, consists of two parts: Firstly, of that uniform elongation, which is proportional to the length of specimen; and secondly, of that which is independent of the length, or so-called local elongation, which is dependent upon the contraction of area at the location of rupture. The larger the diameter of a testpiece the greater is the local, and consequently also the total, elongation of a given length of specimen. The total per cent. of elongation consists of two corresponding parts; it is smaller as the specimen increases in original length with the same cross-section, or as the cross-section diminishes with similar lengths.

There is no difficulty in separating the local from the proportional elongation by measuring the elongations of each centimetre of original length over the entire specimen, and plotting them.

Let us consider two testpieces, of which l and λ are the lengths, e and ε the total elongations, e_1 and ε_1 the proportional or uniform elongations, and therefore $e_{11} = e - e_1$ and $\varepsilon_{11} = \varepsilon - \varepsilon_1$ represent the local absolute elongations after rupture. Let $e\%$, $\varepsilon\%$, $e_1\%$, $\varepsilon_1\%$, $e_{11}\%$ and $\varepsilon_{11}\%$ be the corresponding percentages of elongation. Let us assume that the first specimen has been tested, and the values e, e_1 and e_{11} have been determined; then the problem is the determination of the values of ε, ε_1 and ε_{11} of the second specimen, as functions of e, e_1 and e_{11}.

First Case.—Test pieces have different lengths l and λ, but equal cross-section ω.

*Etudes sur les allongements des métaux après ruptures, par BARBA (Mémoires de la Société des ingenieurs civils, 1880).

It is clear that the absolute total elongation of the second specimen will be:

$$\varepsilon = e_1 \frac{\lambda}{l} + e_{11} \qquad (1a)$$

and the percentage of elongation will be:

$$\varepsilon\% = \varepsilon \frac{100}{\lambda} = e_1 \frac{100}{l} + e_{11} \frac{100}{l} \frac{l}{\lambda} = e_1\% + e_{11}\% \frac{l}{\lambda} \qquad (1b)$$

Plotting the lengths as abscissæ on Fig. 1, and the total elongations as ordinates, we obtain a straight line cutting the axis of Y at a distance of e_{11} from the origin. If we plot the percentage of elongation as ordinates, we obtain a hyperbola, one of whose asymptotes becomes the axis of Y, while the other is a line parallel to the axis of X, and at a distance equal to $e_1\%$.

Tests made by BARBA of specimens all cut from one bar of mild steel having a uniform diameter of 17.2 mm. (.681 in.) and 50, 100 and 500 mm. long (1.97, 3.94 and 19.70 ins.), gave total actual elongations, ε, of 21.0 to 124.1 mm. (.827 to 4.889 ins.) and total percentages of elongation of 42.0 to 24.8%. The contraction of area was 68.5%; tenacity, 52,529 lbs. per sq. in.; limit of elasticity 33,700 lbs. per sq. in. These results substituted in formulas (1*a*) and (1*b*) are plotted at $a\ b$ and $a_1\ b_1$ in Figs. 1 and 2. By prolongation of the line $a\ b$ to the axis of Y we obtain for all the testpieces the local elongation of $e_{11} = 9$ mm. (.3546 in.); for either of the above 10 specimens $\varepsilon_{11}\% = 9\frac{100}{\lambda}$, and therefore the uniform elongation for all testpieces $\varepsilon_1\% = \varepsilon\%$ (total elongation taken from the tables) less $\varepsilon_{11}\%$, calculated. This value $\varepsilon_1\%$ defines the asymptote $A\ B$ in Fig. 2. (A may be considered the center of the hyperbola.)

Curves $c\ d$ and $c_1\ d_1$ in Figs. 1 and 2 represent the results of tests made by BENNETT ("Description of Tensile Tests of Iron and Steel Bars," *Proc. Inst. Mech. Engrs.*, 1886) on specimens of different lengths and almost uniform oblong section (about 47.7 mm. [1.879 ins.] wide and 12.4 mm. [.4985 in.] thick.) These results gave, for lengths of,

12.7 mm. (0.500 in.), 127.0 mm. (5.00 ins.), 254.0 mm. (10.0 in.)
(Eleven different lengths.)

ε = 6.9 mm (.2718 in.), 35.1 mm. (1.343 ins.), 66.1 mm. (2.604 ins.)

$\varepsilon\%$ 54.0% 27.6% 26.0%

Tenacity was 68,250 to 72,500 lbs. per sq. in. and reduction of area was 40 to 50%.

The third set of curves $e\ f$ and $e_1\ f_1$ in Figs. 1 and 2 represent the test made by the Naval Advisory Board on pieces of oblong section, 25 mm. wide (1 in.) and about 16.5 mm. thick (.650 in.). The lengths were:

38.1 mm. (1.50 ins.), 127.0 mm. (5.0 ins.) and 254.0 mm. (10.0 ins.).

ε = 18.7 mm. (.736 ins.), 41.9 mm. (1.65 ins.) and 69.6 mm. (2.74 ins.).

$\varepsilon\%$ = 49.0% 33.0% and 27.4%

with a reduction of area of 57% to 63%.

The curves obtained from BARBA'S tests are the most symmetrical, being undoubtedly due to the homogeneity of the material, and probably also to the shape and uniformity of cross-section.

Formulas (1*a*) and (1*b*) also enable us to determine the relation between the elongation of different parts of the same testpiece.

Second Case.—Testpieces have a circular section and

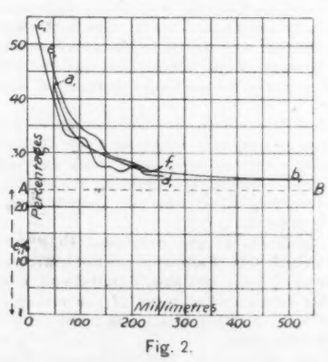

Fig. 2.

equal lengths, but are of different diameters (all are of course cut from one piece of metal).

Let the specimens be described as follows:

l = length of both testpieces,

d and δ = diameters, and

e, ε, $e_1\%$, $\varepsilon_1\%$, $e_{11}\%$, ε_{11} = the same quantities as heretofore.

Assuming that values for e, e_1 and e_{11} are obtained by direct measurements of the first testpiece, then we shall obtain the following formulas for the other specimen:

$$\varepsilon = e_1 + e_{11} \frac{\delta}{d} \qquad (2a)$$

$$\varepsilon\% = e_1\% + e_{11}\% -. \qquad (2b)$$

Diagrams of testpieces of equal lengths and different

diameters, in which values of δ have been laid down as abcissæ and ε or $\varepsilon\%$ as ordinates, are straight lines which intersect the axis of Y at points from the origin at distances equal to e_1 and $e_1\%$.

These formulas apply not only to specimens of circular section, but also to those that are oblong, provided they be similar.

As yet there exists very few tests corresponding to the second case. BENNETT'S tests with specimens of 254 mm. (10 ins.) length gave:

For diameters of 12.7 mm. (.50 in.).....36.6 mm. (1.44 in.)
ε = 18.3%.....29.5%

with a tenacity of 52,500 to 54,000 lbs. per sq. in. and a reduction of 46 to 49%. Several tests by BARBA also belong to this class.

All of these tests verify the above formulas, as the diagrams obtained by them give straight lines.

The law governing variations of elongation when but one cross-dimension is variable (as is usually the case in specifications for inspecting materials in ordinary practice) has not yet been investigated.

Third Case.—For the general case, in which length l and λ, as well as diameters d and δ, are variable, we obtain by using formulas (1) and (2) the following:

$$\varepsilon = e_1 \frac{\lambda}{l} + e_{11} \frac{\delta}{d}, \qquad (3a)$$

$$\varepsilon\% = e_1\% + e_{11}\% \frac{l}{\lambda} \frac{\delta}{d}, \qquad (3d)$$

which again, similar to formula (2), are applicable only for similar cross-sections. When testpieces have similar dimensions (proportional) throughout, *i. e.*, when $\frac{l}{\lambda} = \frac{d}{\delta}$ formulas (3) become

$$\varepsilon = e \frac{\delta}{d}, \qquad (4a)$$

$$\varepsilon\% = e_1\% + e_{11}\% = e\%. \qquad (4b)$$

which express BARBA'S law, proved by three series of tests with cylindrical and one with flat testpieces.

From the above investigations and the tests referred to are derived corollaries stated by the Russian engineer BRANDT as follows:

a. Formula (4), BARBA'S law, is fully proved.

b. Formula (1), for equal sections and varying lengths has also been fully proved.

c. Formula (2), for equal lengths and varying cross-sections of similar shapes, still requires to be proved by a greater series of tests before it can be regarded as fully established.

d. The logical variation of elongation of testpieces of equal length (say the standard 8-in. length), while one or other of the cross-dimensions varies without preserving similarity of cross-section, has not as yet been investigated.

Engineers know very well that this last case is the one which causes so much trouble in inspecting materials, because it is the most convenient and appropriate to make testpieces, when they are to be strips, of a uniform length and breadth (standard) and of a thickness equal to that of the material (as in plates, etc.). In investigating this problem of our conferences (stated in the title of this paper) this case particularly should be kept in view, and it would be highly desirable to test these formulas for different particular cases. I have already stated that it is frequently customary in France in testing materials to make practical use of BARBA'S law.

Alternating Currents for Transmitting Power.

One of the most interesting features of the International Electric Exhibition at Frankfort is the long-distance transmission plant, which delivers about 300

Fig. 1.

Fig. 2.

HP. at that city from Lauffen, on the Neckar River, over 108 miles distant. At a recent meeting of the Society of German Mechanical Engineers, Prof. FR. VOGEL gave a description of this plant, and the following abstract of the address is reproduced from *Glaser's Annalen*, as giving a good idea of this important branch of engineering:

In every plan for the electrical transmission of power, an important factor to be considered is the conductor. Every electrical conductor changes a portion of the current passing through it into heat, and the energy so changed is of course lost for all practical purposes. The loss of electrical energy is dependent on the length, cross-section and material of the conductor, and the strength of the current. If the length be designated by l, the cross-section by q, the current by i, and the constant for

Fig. 3.

the material of the conductor (called its specific resistance) by a, then the loss in electrical energy per unit of time is $i^2\, a\, l \div q$.

From this expression it will be seen that for any fixed length of conductor the loss varies inversely as the cross section and directly as the square of the current. In order to increase the current over a conductor with the same fixed rate of loss it is therefore necessary to increase the cross section of the wires, *i. e.*, to increase the capital paid out for the conductors. But as the length of the conductor is increased, it is evident from the formula that the cross section of the conductor must be increased. At a certain point the cost of these conductors becomes so great that the plant is then financially impracticable.

There remains but one means, then, of transmitting energy to a considerable distance by electric methods and that is by diminishing the current and increasing the pressure, or head under which it works, since the total energy transmitted (current multiplied by pressure) is unchanged in this case. Consequently electricians are now interested in developing safe and economical methods of working with great pressures, a large number of volts, and small currents, or few amperes. The alternating current is especially adapted for such work.

By alternating currents are understood such as change not only their intensity, but also their direction very rapidly. The old Siemens' alternating dynamo, shown diagrammatically in Figs. 1 and 2,

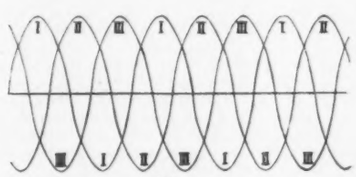

Fig. 4.

is a typical generator of such a current. Fig. 1 represents an iron ring on which are a number of magnet poles, $N\,S$, while before the poles revolve the spools of covered wire A, which form the essential part of the armature. The wire on these spools can be connected so that the current flows regularly through the whole set, or they may each be connected to a common conductor, or be connected by a combination of these methods. The course of the current in one of the spools is as follows:

When the spool is directly between two magnet poles so that its axis coincides with theirs, no current is generated. During the partial revolution to the next pair of magnets, the current rises to its maximum upper value and sinks again to nothing as the poles are passed. But the magnetic character of these poles is opposite to that of the first pair, and therefore, as the spool continues its revolution, the current in the wire with which it is wound flows in the opposite direction. As the ring continues to revolve the spool is brought in front of a third pair of poles, magnetized like the first, and the current accordingly rises again. Fig. 3 gives a sketch of the fluctuations of the current; the abscissas representing intervals of time, and the ordinates to the curve the amount and direction of the induced current.

The amount of the alternating current, or its amepres, depends upon several things, and its calculation is not as easy as if the flow of electricity were continuous. But it is clear that it is continually changing, and it is sufficient for the present purpose to know that it varies between a maximum amount in one direction and a maximum in the other, passing through an intermediate zero point, where there is no current.

The time that elapses between successive similar conditions of the current is called its phase—that is, it is the length of the abscissa in Fig. 3, between each second intersection of the curve with the horizontal or zero line.

Just as a dynamo for generating constant currents will also act as a motor when such currents are sent through its parts properly, so may an alternating current dynamo act as a motor with alternating currents. But in the latter case certain special conditions must be fulfilled. Since no current was generated in the armature spools when these were in a symmetrical position with regard to the magnets, so likewise no force is developed when the spools occupy a similar position and they are traversed by a current. In fact, a current at such a state of affairs would be a waste of energy, and it is therefore plain that the alternating current supplied to a motor must pass through zero, or change its polarity, when the spools of the armature are opposite the magnetic poles.

But even with this condition satisfied, there is still a waste of energy, and an irregular change of

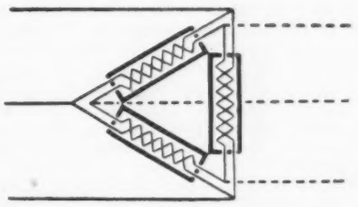
Fig. 5.

polarity has an injurious effect upon the regularity with which the motor works. When a spool leaves one pair of magnets and approaches the next, the first pair should repel and the second attract it. But if the polarity of the current changes before the spool reaches the second pair of magnets, then the opposite effect is produced. Hence it is plain that the motor and the alternating current supplied to it, must have like phases or be synchronous.

With such a motor the direction in which the armature revolves depends upon the direction of the first impulse of the current, and it is plain that its operation is liable to be easily interrupted. In certain positions of the armature the torsion is very small or entirely lacking even with powerful currents, and as the further revolution of the armature in such positions depends upon its kinetic energy, any sudden application of a load at such a moment might have disturbing results.

But it is possible to construct alternating current motors in which the armature receives no current from outside wires. Suppose the armature in Figs. 1 and 2 is enclosed, while the magnets, heretofore regarded as of constant polarity, receive an alternating current. In such a case the polarity of the magnets constantly changes with every change in the current which induces them. If the current drops the polarity also diminishes, and vice versa, so that we may assume Fig. 3 to represent in such a case the fluctuations in the polarity of the magnets.

But when the magnets show such fluctuations the induced currents in the armature will also show like variations. Between the firmly fixed magnets and the wire on the armature spools, attraction and repulsion will now take place just as if the armature received an alternating current from outside. Hence such a machine can also serve as a motor.

The direction of the rotation is fixed in such a case, since it depends entirely upon the fluctuating currents of the field magnets, although there still remain neutral points where there is no rotative force acting upon the armature and its motion is continued by its kinetic energy. Synchronism is also essential here.

It remained for FERRARIS to discover a means to

make alternating current motors available for practical uses. Alternating currents of fixed phase were indeed used for lighting purposes. A current of high tension but small quantity could be transmitted over long lines without too great a cost of conductors. At suitable places these currents were changed by a special sort of induction apparatus, called transformers or secondary generators, to larger currents of diminished tension, but even these latter currents, known as secondary, were not suited for motors.

The case is different, however, when three alternating currents of opposing phases are considered. In order to understand such a current, as now employed at the Frankfort exhibition, assume three dynamos like those in Figs. 1 and 2, united. The armatures are fixed to a common shaft. The fixed magnets are so arranged that between two successive north poles on the first machine, similar poles on the second and third machine are placed so as to equally divide the angular space between them. The armature spools are similarly arranged.

When the shaft is revolved alternating currents are generated in each armature, and on following the current in each dynamo the same curve shown in Fig. 3 will be traced. The rise of the current from zero to a positive maximum takes place in the three armatures at different times, and Fig. 4 shows the fluctuations when all the currents are considered, I designating that from the first dynamo, II that from the second and III that from the third.

If the conditions in the conductors of the three currents are precisely alike, then the currents will bear the same relation to each other as the tensions, represented in Fig. 4. The positive maximum in a spool of the second and third armatures lies between two successive positive maximums of the corresponding spool of the first armature, so that the phases are similar, and the maximum current is successively delivered from the first, second and third armature.

In actual practice, three separate dynamos driven by the same shaft would be never used, but the entire mechanism consolidated on one frame.

These three currents, although giving currents that are not synchronous, may nevertheless be used to operate one motor. The magnets of the latter are placed like those of the dynamo. Following out the changes of polarity in the magnets, it will be seen that a certain magnet of the first motor is increasing in a positive or north direction. After reaching a positive maximum, it sinks again to zero, but before the latter point is reached, the magnetism in the corresponding pole of the second motor increases, and when the latter sinks in turn, the third dynamo develops a similar condition. Hence the positive maximum shifts from one dynamo to another in regular sequence.

Just as in the simple alternating current motor before described, the changes in the fixed magnets induced currents in the armature spools, so in the compound motor similar currents are produced, and the resulting repulsions and attractions tend to revolve the armature in a definite direction.

The essential difference between the simple and compound types lies in the fact that with the latter there is never a moment when the armature can be without a current, and certain of the magnets must always have a definite polarity. When one set of magnets and spools is passing the zero point another set is exercising nearly its full power, and, therefore, such a multiple current motor is automatic and may be loaded and unloaded with but little more difficulty than a constant current motor.

It is no detriment to such apparatus that the current is not supplied to the armature by brushes, but is generated by induction from the fixed or field magnets.

From what has been said it might be inferred that 6 conductors were necessary between dynamo and motor, since 3 separate sets of magnets and spools have been mentioned. These 6 wires may be reduced to 3, however, if they have equal resistances. The return conductor of the first current may be regarded as the outgoing conductor of the second, and the return of the second as the outgoing of the third, and so on. By examining Fig. 4 it will be seen that such a condition is possible without interference from opposing currents.

The transmission plant between Frankfort and Lauffen is operated with such motors. The armature is wound to give a current of 1,400 amperes at a tension of 50 volts. As the usual form of dynamo is not adapted for such large currents, the armature is stationary and the magnets revolve. The commercial efficiency of the dynamo is 96%. In order that the great length of the conductors may not be too expensive, a very high tension, averaging 30,000 volts, is employed. The currents are led to a triple transformer, Fig. 5, outside the station, which changes them to the high tension currents by induction, as already described. Likewise outside the motor station at Frankfort, a second transformer reduces the tension and increases the amount of current, and in this condition is delivered to the motors.

Great difficulties attend the insulation of the conductors of currents with such enormous tensions, some idea of which may be gained from the fact that the entire transformer is surrounded by oil, which may account for the use of the term "oil-transformer" in the daily press. Special apparatus had to be devised to prevent the currents escaping to the ground, and a watch is kept at every point to guard against leakage.

A New Camel for Raising Vessels.

A new form of camel, or pontoon, for raising sunken ships has been invented by Mr. CHARLES H. BROWN, of Port Huron, Mich., and is thus described in the Detroit *Free Press*:

There are two pontoons, the hulls forming the water chambers and the tops being the main decks. Upon the main decks are deckhouses. The hulls are partitioned off into a suitable number of water compartments. Two of the compartments in each hull are connected with the main well by conduits. These conduits are controlled by valves which have the shafts provided with suitable hand-wheels extending through the upper deck. Two more compartments, one in each pontoon, connect with the well, and are controlled by similar valves having similar shafts. The suction pipe extends into this well and connects with a suitable pipe having a discharge pipe extending through the side of the deckhouse. This pump is driven by any suitable engine located in a pumphouse, which the inventor would preferably place beneath the upper deck and within the deckhouse. Suitable vents are provided for the lower main chambers and for the deckhouse, and inlet valves control openings in the lower side of the hull, to be used in filling the hull with water.

On the inner side of a pontoon thus constructed the inventor forms a series of pockets or wells through the hull, and a series of corresponding pockets through the deckhouse, the pockets in the house being wider than the former, thus forming a shoulder at the junction of the two which makes a bearing for a block, suitably apertured, to pass through, a pin or shackle being used on the top of this block to hold the chain in its adjusted position. A stanchion is made fast above the well; upon it is secured a sheave, and at the base is another sheave. Over these sheaves is looped a rope, which has a suitable hook to be fastened to the chain, and at its other end connecting with the winding drum in the engine-room, by which the chain may be raised or lowered by the engine.

To offset the loss in buoyancy upon the inside of the pontoons caused by forming the wells the inventor places the water-ballast tanks upon the opposite sides of the pontoons, and they are kept filled with water at all times, so that the pontoon may remain as nearly level as possible.

The parts being thus constructed and arranged, they are intended to operate as follows: The pontoons being towed over the sunken vessel, the valves are opened, the hulls gradually fill with water and the pontoons sink. If the lift is great, the pontoons can be still further sunk by opening the valves in the deckhouses, so as to partially fill them. The engine-house, being water-tight, will be entirely secure, although partially under water. The chains may now be adjusted beneath the vessel, and passed upward through the wells and through the blocks and secured to their adjusted position by means of the tackle as before described. When the chains have been properly secured the water is pumped from the holds of the pontoons, and their buoyancy causes them to rise. The valves being open, the water flows out from the deckhouse as the pontoons rise. When the water is entirely pumped from the hull and the full effect of the buoyancy of the pontoons exerted in lifting it as far as possible, the pontoons are towed into shallow water until the vessel rests upon the ground. The pontoons are separated a sufficient distance to allow the vessel to come between them, and are held in their separated position by means of girders secured in suitable bearings formed upon the main deck. The chains are carried to the upper deck, and pass through suitable blocks thereon, and the pontoons can be filled, pumped out and the vessel lifted, when it will be in ordinary cases clear from the water, and may then be towed to any desired point.

Transportation on the Ohio River and its Tributaries above Cincinnati.

A very good idea can be formed of the extent of inland navigation in the United States and the value of the commerce thereon by looking over Census Bulletin No. 88, which deals with the Ohio River system alone out of the many systems in this country.

There are 928 miles of navigable water on the Ohio River and its tributaries above Cincinnati, and including the 500 miles between Cincinnati and the mouth of the Ohio, 1,428 miles. The cost of improvements on the waters above Cincinnati was $12,129,713, or $8,494 per mile of navigable route. Including ferry passengers the total number carried on these waters in 1889 was 2,573,396, and 10,744,063 tons of freight were moved. The ton mileage of this freight movement has been computed at 2,076,866,145.

The tributaries of the Ohio included are given, with their lengths and other data, in the following table:

LENGTH OF NAVIGABLE WATERS AND EXPENDITURES ON THE SAME FOR IMPROVEMENTS.

RIVERS.	Number of navigable miles.	COST OF IMPROVEMENTS OF RIVERS.			Average cost per mile.
		United States expenditures.	All other expenditures.	Total.	
Ohio	967	$5,056,479	.....	*a*$5,056,479	$5,229
Monongahela	102	377,552	$1,906,284	2,283,836	22,391
Allegheny	45	180,000	.....	180,000	4,000
Muskingum	75	532,504	1,628,028	2,160,532	28,807
Little Kanawha	40	.....	230,365	230,365	5,759
Great Kanawha	80	1,976,203	.....	1,976,203	22,205
Big Sandy	110	242,298	.....	242,298	2,203
Total	1,428	.....	.....	12,129,713	8,494
Less mileage below Cincinnati on the Ohio	500				
Total mileage	928				

a Exclusive of combined appropriations for this and other rivers.

The most important improvements on the Ohio are the Davis Island dam, forcing slack water back to Pittsburg, and the Louisville & Portland Canal, at Louisville. Improvements on the Monongahela began in 1840 by a corporation still in existence which now owns 7 locks and dams carrying slack water from Pittsburg to Geneva, a distance of 85 miles. In 1872 the general government undertook the improvement above Geneva, to Morgantown, West Virginia, a distance of 17 miles. The four lower dams have locks measuring 220 × 56 ft., and the bulk of the coal shipped down the river is moved from these pools.

The improvements of the Allegheny were commenced by the government in 1879; these are mainly above the limits of steam navigation and consist of a number of dams with timber-chutes. Work on the Muskingum was commenced in 1888. At present steam navigation extends to Zanesville, 75 miles from the Ohio. On this length there are 10 locks, 157 × 36 ft. with a total lift of 118 ft. In May, 1889, all through navigation was suspended and the works placed under repair. The Great Kanawha River enters the Ohio 203 miles above Cincinnati. Improvements were commenced in 1873 and since then 5 locks have been built measuring 300 × 50 ft.; of the five dams 3 are movable and 2 fixed. The Little Kanawha, with a total length of 150 miles, has been improved for 40 miles above its junction with the Ohio by 4 locks and dams. Work is in progress extending navigation 12 miles further. The Big Sandy, taken with its tributary, the Levisa, furnishes 110 miles of light-draft steamboat navigation during 6 months of the year. These streams are mostly used for rafting timber, but long, narrow push-boats, of 10 to 15 tons, burden, are much used.

Concerning floating equipment, the Ohio alone above Cincinnati is credited with 713 boats. Of these 46 were passenger steamers, 37 ferry steamers, 93 towing steamers, 17 tugs, 9 miscellaneous and 511 barges. Of course many of these barges pass on down the whole length of the river and beyond. The total number of vessels on all the rivers is 5,214 and total tonnage is 2,526,415, and its value is $6,111,813. It should be noticed that 97.78% of this tonnage is low grade, used chiefly for transporting coal, lumber, sand, stone, etc. The value per ton of this

equipment is $1.17 as compared with $53 per ton for lake equipment.

Concerning the character of the freight movement, the following gives this data for 1889:

Character of freight (in tons).	Ohio.	Monongahela.	Allegheny.	Muskingum.	Great Kanawha.	Little Kanawha.	Big Sandy.
Coal	4,338,427	.....	.....	....	1,076,871	2,300	.....
Coal and Coke	.....	3,059,418	.....	....	.....	.....	.....
Salt	65,550	.....	.....	....	.....	.....	.....
Clay, sand and stone	76,877	98,359	80,750	....	.....	2,160	.....
Lumber	617,473	81,209	275,861	....	43,313	99,561	274,330
Iron ore	.....	35,563	.....	....	.....	.....	.....
Unclassified	330,516	20,922	9,335	10,041	25,018	8,681	12,163
Tons—Total	5,528,857	3,294,952	365,946	10,041	1,145,202	112,602	286,493

As is evident from the above, coal is the chief article of freight. The division of this traffic is given in the following table, for the coal traffic on the Ohio River:

AMOUNT OF COAL SHIPPED FROM PLACES NAMED AND THE DISTANCE CARRIED EXPRESSED IN TON MILEAGE.

From	Tons	Tons moved one mile.
Total	4,338,421	2,973,733,387
Pittsburgh, Pennsylvania	3,073,232	2,712,162,662
Point Pleasant, West Virginia	1,067,857	231,087,122
Pomeroy, Ohio	136,900	23,780,489
Ashland, Kentucky	42,530	6,013,546
Bellaire, Ohio	17902	467,568

Temperature in Deep Bore Holes.

At Sauerbrunn, in Bohemia, observations for temperature have lately been made by Dr. J. PULUJ. The hole was 433 ft. deep; the upper half was lined and it was filled with water containing carbonic acid gas to within 20 ft. of the surface. The observations were made by an electrical thermometer; the variation in the resistances of a carbon filament and an iron wire, with change of temperature, served by the determinations on a Wheatstone bridge to give the temperature at various positions fixed by a sounding line containing the necessary conductors.

The temperatures when plotted were shown to be constant, on Jan. 2, for distances between 20 and 40 ft. below the surface; then up to 66 ft. it increased rapidly, and from 99 to 426 ft. it increased in arithmetical ratio with the depth. The temperature (Centigrade) at a given depth h (in metres) may be expressed as follows:

$$T = 11.459 + 0.03118\,(h - 30),$$

whence the temperature increases 1° Centigrade for each 32.07 metres of depth, or 1.8° Fahr. for each 105 ft. of depth.

"The Abstracts of Papers" of the Institution of Civil Engineers, which translates the above from the *Repertorium der Physik*, 1891, p. 301, gives further a table of conditions for other bore-holes, with which this is compared. In this table the first two columns of figures give the depth in metres, and the last the depth in metres corresponding to a rise of 1° Centigrade:

	Metres.	Metres.
Schladebach (near Meneburg)	6 to 1,716	36.88
Sennenitz (near Halle)	754 to 1,084	36.66
Leith (near Altona)	426 to 1,250	35.07
Sudenburg (near Magedeburg)	30 to 508	32.36
Sperenberg (near Berlin)	220 to 1,066	32.00
Sauerbrunn (Bohemia)	30 to 130	32.07

WORK ON THE JEFFERSONVILLE BRIDGE has been stopped for this year, says the Indianapolis *Journal*. The Phœnix Bridge Co. has removed its workmen to Jackson, Ky., where that company is at work on the Kentucky Union railway bridge.

PERSONALS.

Mr. CLARK LIPE, railway contractor, died at Denver, Col., Aug. 12.

Mr. CURTIS MILLARD, of Springfield, Mass., has gone to Sumter Co., S. C., on railway work.

Mr. CHANNING M. BOLTON, Chief Engineer of the Richmond & Danville R. R., will locate his office at Atlanta, Ga., on and after Sept. 1.

Mr. JOHN S. GILBERT, naval architect and inventor of the balance dry dock, died at Fort Montgomery, near West Point, N. Y., recently. Mr. GILBERT incorporated the original New York Dry Dock Co., and built the Erie Basin Dry Dock 40 years ago. He erected other dry docks in America and in Europe, and was also a naval constructor at Washington.

MR. A. GOTTLIEB, late Chief Engineer of the Bureau of Construction of the World's Fair, has resigned his position. In a letter to Chief of Construction D. H. BURNHAM, he writes that his duties are so important and onerous that it was impossible to do them justice and at the same time attend to his private business, which latter could not be neglected. The resignation has been accepted and the thanks of the Construction Committee extended to Mr. GOTTLIEB for his uniform courtesy and zeal. His salary was extended to Aug. 31.

Mr. FRANK P. DAVIS, now the chief assistant of Engineer MENOCAL, of the Nicaragua Canal Construction Company, stationed at Greytown, Nicaragua, has been the recipient of so unusual a mark of recognition for services rendered as an engineer that we give the resolution of the company in full, and congratulate Mr. DAVIS on his good fortune and the officers of the Canadian Pacific Railway on their frank admission of indebtedness to their engineer for good work done eight years ago. The resolution reads as follows:

"At a meeting of the Board of Directors of the Canadian Pacific Railway Company, held at the principal offices of the company in Montreal, on Monday, the eighth day of June, 1891,

"The president referred to the especially valuable services of Mr. FRANK P. DAVIS, who as engineer on the Rocky Mountain section of the line under Major A. B. ROGERS, prevented a most serious mistake in the location of the railway in the Lower Kicking Horse Cañon, and saved the company a large amount of money in its original construction, as well as in its subsequent operation; and stated that when the facts came to the knowledge of the executive officers, they felt that Mr. DAVIS' services should be fittingly recognized, and that Mr. DAVIS had left the country and his place of residence was not known until within a few weeks.

"The President recommended that a check for a suitable amount be sent to Mr. DAVIS, with a resolution expressing the appreciation of the board, whereupon it was

"RESOLVED, that the recommendation of the president be concurred in, and that he be authorized to forward to Mr. FRANK P. DAVIS a cheque for one thousand dollars, together with a copy of this resolution as an acknowledgment of the valuable services rendered by him to this company.

"(Attest). C. WAINWRIGHT, Secretary."

NEW PUBLICATIONS.

—*Safe Railway Working.* A Treatise on Railway Accidents, Their Cause and Prevention, with a Description of Modern Appliances and Systems. By CLEMENT E. STRETTON, C. E. Crosby Lockwood & Son, London. Second edition, 1891. Cloth, 7½ × 5½ ins.; pp. 214; illustrations, 52; plates, 2. Price, $1.

We have in other book reviews commented upon the fact that English publishers issue technical books in better form than American publishers, the tendency of the latter being to make the book larger than necessary and often very unwieldy. The book which we have now before us is a good sample of the average English practice, being compact and hardy in form, and well printed in clear type on good paper. The index is fair, but might be made more complete. The cuts are scarcely up to the standard of the style of the book, and are not very well printed.

The book under review is of a different character from that by Mr. CHARLES FRANCIS ADAMS on "Railway Accidents," going more into details of methods and safety appliances, and less into the description of individual accidents. Mr. STRETTON is well known in England in connection with this kind of work, having devoted considerable time and attention to the examination of appliances for insuring safety in operation, and to the investigations of accidents. The first edition was published in 1886, and many of the statistics in the first part of the book are only brought down to that date, but some additional matter is given in a supplementary chapter. The book refers entirely to English railways.

Chapter 1 contains a brief summary of the accidents of 1889, with the suggestions for safe railway working compiled by the author in 1885. These recommendations include the absolute block system and a uniform code of regulations; improvements in switch and signal and interlocking plant; continuous brakes; efficient means of communication between the passengers and the engine driver and conductor, the present cord system being unreliable, and the plan of having no communication on trains running less than 20 miles without a stop being risky to the public; crank or driving axles of locomotives to be taken out after they have made a certain mileage, 200,000 miles for iron and 180,000 for steel being recommended; tires to be so fastened to the wheels that they cannot fly off if broken freight car couplings to be used which will not require men to go between the cars; overwork to be abolished, a day's work to be 10 hours; 8 hours of signal box work, or 6 hours at a time at large and busy stations; time tables to be made up so that trains can keep time. No reference is made to bridge floors, guard rails or rerailing guards for bridges; the floors of English railway bridges are generally very solid, and guard rails of some kind are generally provided, but rerailing guards are little used, and suggestions on these points might well be included. Derailing switches are not considered, except as "catch points" or inclines.

Chapter 2 on "Permanent Way, Ancient and Modern," is devoted to the history and development of the track, and the author states that "nothing can be worse than a rigid permanent way," a remark with which some American engineers will not agree. According to the author, the track must be strong and firm, "but at the same time possessing a certain amount of elasticity; it is very necessary that the elasticity should be uniform throughout, and not a system of alternate elasticity and rigidity, in which it serves to aggravate the rigidity by causing a succession of jumps and jerks." [Perhaps uniform rigidity would be as good.—ED.] Ballast covering the ties tends to keep the roadbed wet, but makes a very quiet riding track, while with ballast not covering the ties the track is dry but noisy. Reference is made to steel ties on the London & Northwestern Ry. and Northeastern Ry.; they are said to cost about twice as much as wooden ones, but will doubtless last a long time, and are costing less in maintenance.

Chapter 3 is on "Railway Signaling," giving statistics of the extent to which interlocking and the block system were in use in 1884. The operation of the block system is described, and the codes of some of the leading railways are given. Particulars are also given of signal plant and the interlocking of switches and signals. Mr. STRETTON is very strongly in favor of the absolute block system. He also thinks that one code of signal regulations and one pattern of signal should be adopted. For lights he recommends red for "track blocked," green for "track clear" and white for back lights. The system of operation by telegraph orders is said to be extremely dangerous, which it certainly is, particularly on main lines.

Chapter 4 is on "Railway Brakes." Particulars are given of the brake tests made in 1875, '79 and '80, but no reference is made to the later foreign trials of the Westinghouse brake. The desirability of having a uniform brake system is pointed out, but it is also shown that there is on English railways a great diversity. Mr. STRETTON considers that there are only two systems of continuous brakes there in use which can be considered, efficient, or which are likely to come into permanent use, viz., the Westinghouse automatic air brake and the Vacuum Brake Co.'s automatic vacuum brake, both of which are described. No mention is made of continuous brakes for freight trains.

Chapter 5, on "The Breaking of Locomotive Driving Axles," gives statistics of the mileage and breakage of iron and steel axles, both straight and crank; methods of strengthening the webs of crank axles are described, including hooping, and the author's method of running bolts through. Chapter 6, on "Improved Couplings for Railway Wagons," is not of particular interest to American readers, as the couplings belong to types not used in this country. Chapter 7, on "Railway Servants and the Law," mentions numerous instances in which employees have been punished for accidents which were due to the negligence of railway companies in using insufficient brakes, signal apparatus and other appliances, and to the use of faulty methods of operating.

Appendix 1 is on "Railway Traffic Returns," in which the author points out the advisability of catering for the third-class traffic, and recommends the introduction of third-class dining and sleeping cars. Appendix 2 gives a summary of the railway signal returns for 1885. Appendix 3 gives a report by Mr. STRETTON on the Continuous Brakes Return of 1886, pointing out several inaccurate statements. Appendix 4 is on "Mixed Trains," and recommends that the passenger cars should be placed in front of the freight cars. The supplementary chapter gives further and more recent information as to the several points dealt with in the earlier part of the book, with several pages on "Locomotive Development," and a cut of the steam sand blast.

The book is both useful and interesting to the professional reader, and is of a sufficiently popular character to be understood by those of the general public who are interested in the railway question and in the protection of railway employees during the performance of their duty. It would be well, however, in later editions, to bring the matter and the statistics more nearly up to date, and to go into further detail in regard to recently introduced improvements in appliances and methods. We would also suggest to Mr. STRETTON that it would be a good plan to prepare for a third edition of his book, or for separate publication, general descriptions of and comments upon some of the most serious and significant accidents on English railways.

—*The Railway Companies and Railway Brakes.* NORMAN D. MACDONALD, Edinburg, Scotland. Reprinted from *The Scotsman*. Flexible cloth, 4¼ × 7¼ ins.; pp. 62.

The author states in his preface that his aim has been to help the public realize what an important matter a good railway brake is, "as well as to show how, in a manner almost inconceivable, a great many attempts have been made to introduce systems which were most dangerous." The paper deals with the history of the brake question in England, giving particulars of a number of accidents bearing significance on this question, and showing some very remarkable facts concerning the brake systems used within recent years on English railways.

The necessity of an automatic continuous brake is clearly shown, while many railways for years used simple continuous brakes. Of the two systems now in general use—the Westinghouse automatic air and the automatic vacuum brakes—the writer shows the superiority of the former. The paper itself occupies 32 pages, the remainder being devoted to the correspondence which it brought out, which is by no means the least interesting or useful part of this little book, which we would commend to the study of English railway directors and executive officers.

—*Locomotive Development.*—Compiled for the Associated Society of Locomotive Engineers and Firemen, by CLEMENT E. STRETTON, Consulting Engineer to the Society. Paper, 5⅛ × 8⅛ ins.; pp. 40; numerous cuts. T. G. Sunter, Leeds, England. Price, 10 cts.

This paper begins with TREVITHICK'S locomotive of 1803, and gives the history and general dimensions and particulars of many of the old English engines, showing the gradual development of the present types of locomotives. The American locomotive, "Old Ironsides," built in 1832 for the Philadelphia, Germantown & Norristown R. R., is also described, but in the brief note on the engine with a "bogie," or truck, built by R. Stephenson & Sons, in 1833, for the Saratoga & Schenectady R. R., no mention is made of Mr. JOHN B. JERVIS as the inventor of the "bogie" or truck for locomotives. Some of the latest types of English locomotives are described and illustrated, and there is an appendix on "Valve Gear."

SOCIETY PROCEEDINGS.

International Congress of Hygiene and Demography.

[FROM OUR LONDON CORRESPONDENT.]

There has been a gathering of eminent men in sanitary science from all parts of the world in London in order to take part in the Seventh International Congress of Hygiene and Demography. This Congress is really international, not merely nominally so, as is often the case in "international exhibitions," and the proceedings have been carried on in English, French and German. The papers submitted for discussion have been of formidable number, while the preliminary programme in itself occupied forty-eight pages. With only a week to get through the business, naturally the business has been somewhat hurried and a time limit has been put upon readers and speakers.

The Congress meetings have previously taken place in Brussels, Paris, Turin, Geneva, The Hague and Vienna, so that there has been no undue hurry in making London the headquarters for once. The Presidency of the Congress was offered to the Prince of Wales, who accepted the position and took part in the initial proceedings.

The Congress was divided into two divisions and ten sections. The first division was devoted to hygiene, preventive medicine, bacteriology, relation of the diseases of animals to those of man, hygiene of infancy and childhood, chemistry and physics in relation to hygiene, architecture in relation to hygiene, engineering in relation to hygiene, and state hygiene. The second division formed the tenth section, and was devoted to demography, health statistics and industrial hygiene. By the way, demography is a term which is novel enough to have caused the executive to officially explain it as meaning the study of the life conditions of communities from statistical points of view. Meetings of sections were held in the rooms of the Society of Antiquaries, of the Royal Society, of the Chemical Society, of the Geological Society, of the Linnæan Society, and the Astronomical Society, all of which are situated in Burlington House, while other sections have met in the University of London and the Museum of Geology, which are in the same locality.

The opening meeting was held on Monday, 10th August, in St. James' Hall, Piccadilly, and was densely crowded by all sorts and conditions of men—and of women. In opening the proceedings of the Congress the Prince of Wales drew attention to the important recognition of useful nature of Congress which had been obtained from all quarters. There were, he said, very many dangers to health in the midst of which we had to live. Some of these at present appeared invincible, but the great majority might with care be averted. While he was a member of the Royal Commission on the Dwellings of Working Classes he had learned much of dangers arising from the overcrowding of towns, the building of huge factories, the pollution of atmosphere, the accumulation of refuse, the fouling of rivers, and the impurities of air, earth and water. There was immense difficulty in increasing or even maintaining activity in English branches of trade without incurring heavy risk to health, more particularly in the chief centers of population. He hoped the work of the Congress would not be limited to the influence which it might exercise on sanitary authorities. It would have a still better influence if it would teach all people in all classes of society how much every one might do for the improvement of sanitary conditions among which he had to live. After the Prince had concluded his speech observations were made by Dr. Brouardel, of Paris, Dean of Faculty of Medicine, Paris; by Prof. Von Coler, of Prussian Army Medical Department; by Prof. Corradi, of University of Pavia; by M. Joseph Körösi, Director of Municipal Statistics, Buda-Pesth; by Dr. W. Roth, Surgeon-General of Army of Saxony; by Sir J. Paget and by Dr. G. Buchanan, Chief Medical Officer to the Local Government Board of Great Britain. These proceedings were purely introductory, and the real work did not commence until Tuesday, 11th August, when all the sections started business simultaneously.

The section most interesting to the readers of ENGINEERING NEWS was No. VII., which dealt on engineering in relation to hygiene. The papers were taken in batches, and as they were not always homogeneous, the result was that the discussions were of a desultory order. The section was presided over by Sir JOHN COODE, Past President of the Institution of Civil Engineers, who offered some remarks on the progress of legislation in Great Britain in respect to sanitary matters.

It was about the year 1838 that the public mind of Great Britain became first aroused to the serious and growing evils arising from the absence of proper precautions for the preservation of the health of dwellers in the large towns and cities generally, and more especially in London. The ultimate result was the establishment of the local government board, the prominent name in the work being that of Sir EDWIN CHADWICK, and latterly Sir ROBERT RAWLINSON had done good work in the engineering department of board.

London being the largest of the great cities of the world, Sir JOHN gave some facts which give an idea of its magnitude. The population of the metropolis of England is in round figures 5,660,000, which is a number greater than that of the inhabitants of Paris, Berlin, Vienna and Rome combined. The main intercepting and principal branch sewers which have been constructed for the conveyance of the sewage of London to the two outfalls into the River Thames at Barking and Crossness, respectively, measure about 80 miles in length. Since the year 1856 there had been expended on the main drainage works alone the sum of nearly £6,000,000. Up to the end of 1890, the eight Metropolitan Water Supply companies had expended upon works for the supply of water to London a sum very closely approximating to £15,000,000. The average quantity of water delivered each year to the inhabitants of London, for domestic purposes alone, was 24.75 gallons per head of population per diem, and in point of quality but little, if at all, surpassed by the supply in any other city in Europe. The water is conveyed through pipes, the united length of which is about 4,760 miles. The total volume of water delivered for domestic purposes only in 1890 was 61,000,000,000 gallons. For raising this large quantity the companies employed 184 steam pumping engines, having an aggregate of 21,659 HP. As another illustration of the magnitude of London it may be mentioned that the streets and roads within the metropolis, if placed end to end in one continuous line, would measure about 2,500 miles. While admitting that the extensive drainage works had been executed, and the large expenditure had been increased for improving the condition of London, Sir JOHN COODE could not say that all had been done which might be done in this direction; nor would it be possible to say as much as long as the sewerage of the metropolis was allowed to flow into any part of the Thames without previous purification by the most perfect method as yet known, *i. e.*, by being filtered through land. The only alternative would seem to be the conveyance of the sewage to the sea coast beyond the mouth of the estuary of the Thames.

The first paper read was on "Sewage Disposal with Reference to River Pollution and Water Supply," by Prof. HENRY ROBINSON, M. Inst. C. E., F. G. S., F. R. M. S. He stated that it was of the utmost importance that sewers should be designed to remove and not to retain the foul matters that are delivered into them. This would be impossible if the sewers were made large enough to carry off the bulk of the rainfall. Relief sewers to meet the conditions that occurred during heavy rainfall should be more relied upon than is now the case. Rivers should no longer be regarded as the natural vehicle for removing sewage or manufacturing refuse. The action that had been taken by the State Board of Health of Massachusetts to protect the purity of the inland waters deserved to be specially commended as an example of broad and wise policy in instituting the systematic investigations by engineers, chemists and biologists of all that bears upon the purification of sewage and on the filtration of water. By an act of that state, examinations were made of all waters for the purpose of ascertaining whether they were adapted for the purpose of domestic supply, or were in a condition likely to impair the interest of the public or to imperil public health. The exhaustive reports under these different heads might be fairly stated to be far in advance of anything that had been attempted in Great Britain. The history and condition of a river into which sewage was discharged required to be studied from several points of view, as conclusions arrived at in regard to one river might be totally inapplicable to another. Various systems of sewage treatment were mentioned, and allusion was made to some recent observations by Professor VON PETTENKOFER upon the discharge of the sewage of Munich into the River Iser, and other cases abroad of a similar kind were referred to. The importance of studying the treatment of rivers while under the control of different authorities by joint action was advocated with a view to effectually prevent the pollution of the rivers and the better conservation of them for purposes of water supply.

(To be continued.)

The Summer Meeting of the Institution of Mechanical Engineers.

(FROM OUR LONDON CORRESPONDENT.)

The summer meeting of the Institution of Mechanical Engineers was held this year in Liverpool July 28 to 31 inclusive. Four papers were read, and there were several excursions. The following is a list of the papers: "A Review of Marine Engineering During the Past Decade," by ALFRED BLECHYNDEN, of Barrow-in-Furness; "Description of the Warehouse and Machinery for the Storage and Transit of Grain at the Alexandra Dock, Liverpool," by WM. SHAPTON, London; "On the Experimental Engine and the Alternative Testing Machine in the Walker Engineering Laboratories of University College, Liverpool," by Prof. H. S. HELE SHAW, of Liverpool; "On the Mechanical Appliances Employed in the Construction of the Manchester Ship Canal," by E. LEADER WILLIAMS, Engineer-in-Chief of the canal.

Mr. BLECHYNDEN'S paper was, as indicated by the title, a historical review; and it formed the third chapter in the history of marine engineering contained in the "Transactions" of the Institution. Sir FREDERICK BRAMWELL—not himself a marine engineer, but sometimes known as "the universal engineer," because there is no branch of the profession upon which he is not prepared to give evidence or advice—contributed the first chapter in the form of a paper read nineteen years ago at the 1872 meeting of the Institution, also held at Liverpool. Mr. FRANK MARSHALL, a well-known Tyneside marine engineer, followed with a paper on the same subject at the Newcastle meeting of the Institution held in 1881, and now Mr. BLECHYNDEN has taken up the ball. Mr. BLECHYNDEN is Chief Engineer to the Naval Construction and Armaments Co., so long known as the Barrow Shipbuilding Co., one of our biggest establishments of the kind.

Since Mr. MARSHALL'S paper of 10 years ago, the triple expansion engine has come into general use for marine work, and this topic naturally formed the chief part of Mr. BLECHYNDEN'S paper. He very properly referred to this type as the "three-stage compound," and the "quadruple expansion" he called the "four-stage compound." Triple or quadruple expansion are evidently misnomers, for the expansion is carried far beyond three or four times in either. It is to be hoped that Mr. BLECHYNDEN'S more accurate and convenient nomenclature may find favor with engineers.

Ten years ago boiler pressures averaged 77.45 lbs. per sq. in., piston speed 467 ft. per minute, heating surface per I. HP. 3.99 sq. ft., and coal consumption 1.828 lbs. per I. HP. per hour. Now boiler pressures average 160 lbs., and even go as high as 200 lbs; piston speed average is 529 ft. per minute, heating surface per I. HP. is 3.274 sq. ft., and coal consumption is 1.522 lbs. per I. HP. per hour. We cannot follow the author in his interesting summary, but it may be stated that, taking the averages of 1872 as unity, we find the coefficients of the present time to be: Boiler pressure 3.020, heating surface per I. HP. 0.743, piston speed 1.405, and coal per I. HP. 0.721.

Forced drafts naturally occupied a good deal of the author's attention, as it is a factor in general marine engineering which has come to the fore during the last ten years. There have been a good many mishaps and breakdowns owing to the use of forced draft, but this has been the result of not suiting boilers to the new conditions. The subject is becoming better understood, and forced draft will probably now take its place as valuable auxiliary to the marine engineer. In speaking of corrugated flues, Mr. MACFARLANE GRAY propounded a theory which certainly will not meet with the approval of Mr. SAMSON FOX. Mr. GRAY says that the makers of corrugated furnaces are wrong in claiming that additional heating surface is gained by the corrugations. The heat from the fire, he says, being radiant heat, proceeds in radial lines, and, therefore, no greater area of effective heating surface can be obtained than that due to the plain cylinder.

Mr. SHAPTON'S paper described the warehouse in question, and the grain elevating and transporting machinery. There was nothing very novel about the latter. The bins or silos are 250 in number, hexagonal in section, and 12 ft. across the angles, by 80 ft. deep. Together with the half bins they will hold 2,240,000 bushels. The bins are of brick, 14 ins. thick up to a height of 27 ft., and 9 ins. for the remaining height. A Sprague mixer is used. During the discussion Sir JAMES DOUGLASS suggested that the cellular structure of the granaries should be made with expanded steel lattice covered with Portland cement. This construction would be preferable to brick as occupying less space and not being likely to retain moisture. It would also be far lighter than brick, a point of importance where foundations are not of the best. It would be less

liable to crack through settlement, and as compared with wood, it would not afford harborage to weevils or be subject to dry rot.

Prof. HELE SHAW'S paper described the laboratory engine which has been erected in the new engineering department of University College, over which he presides. This engine is probably the most elaborate experimental engine yet constructed. Perhaps, as was suggested during the discussion, it is too elaborate. It is of the "three-stage compound" type. Prof. HELE SHAW describes it as a triple expansion engine—to indicate 150 HP. at 150 revolutions, the boiler pressure being 200 lbs. The steam connections are arranged so that any combination of cylinders, or any single cylinder, can be worked. The high pressure cylinder is fitted with Stephenson's valve gear, the intermediate with Joy's valve gear, and the low pressure with Hackworth's gear. The cylinders are jacketed at the ends and sides. The cranks are adjustable on the shaft, so that any sequence can be obtained. The low pressure slide valve is of the ordinary double ported type, the other valves are piston valves. It will be seen that almost any combination of work can be exemplified by this engine. The danger will be that the student may get so confused by these protean changes that he will mix the whole lot up together. That will only occur with the stupid ones, however, and it is likely that Prof. HELE SHAW has shown good judgment in the design of this machine. There is of course a surface condenser. The boiler is of the ordinary return-tube type. The engine differs from a marine engine in having a good sized fly wheel in place of a screw propeller. The fly wheel is fitted with a Prony brake, which is a necessary appliance for an experimental engine. It would be an immense addition if a tank could be built, so that a screw propeller could be tried—the fly wheel of course being disconnected—and a dynamometer applied for measuring the thrust. Perhaps this will come later, but in mean while it would be well to remember that a far more equable turning moment is obtained with a big fly wheel and brake than with a screw propeller.

The testing machine is 100 tons, single lever, of the ordinary Wicksteed type, excepting that it has a novel arrangement of alternate centres whereby the machine may be used either with a maximum load of 100 tons or be made four times as sensitive by shifting the fulcrum.

The last paper in the Agenda was, in one respect, the most interesting, inasmuch as it dealt with a great work now in progress. This was the Manchester Ship Canal, the mechanical appliances employed in the construction of which formed the subject of Mr. LEADER WILLIAMS' paper. The Manchester Ship Canal is the largest work of its kind in this country. The excavation amounts to 46½ million cu. yds., of which over 10 millions are sandstone rock. As only about 17,000 men and 200 horses have ever been employed at one time, it is evident that mechanical appliances must be largely used. There are 97 steam excavators, 8 steam dredgers, 173 locomotives, 6,300 trucks and wagons, 124 steam cranes, 192 portable and other engines and 212 steam pumps. About 10,000 tons of coal are burned every month. The greater part of the excavation is done by the steam navvy, which is known in England as Dunbar & Ruston's. It is a modification of the original American machine. The novel machines are the German and French bucket ladder excavators, of which there are seven. In principle they are alike, but there are considerable differences in points of construction, the German being probably the better design, but the French machine is better made. These machines will only work in comparatively light soil, but in suitable ground will do an enormous amount of work, from 2,000 to 2,400 cu. yds. per day. The weight of the French machine is 80 tons and of the German machine 70 tons. The cost of each is about £2,400 ($11,040). The cost of excavating is about 1½d. ($.03) per cu. yd.

The excursions were numerous, the principal being to the Manchester Ship Canal, to Laird's shipyard, the Mersey Docks, Harwich Locomotive Works and the Liverpool Overhead Railway now in course of construction.

American Railway Master Mechanics' Association.—President Mackenzie has appointed the following committees for conducting the business of the year 1891-92:

No. 1. Exhaust Pipes, Nozzles and Steam Passages.—C. F. Thomas, A. W. Gibbs, L. S. Randolph, J. M. Wallis, Geo. W. Smith, Robert Quayle, John Y. Smith.

No. 2. The Present Status of the Car Coupler Question.—John Hickey, G. W. Rhodes, Sanford Keller, R. H. Blackall, M. N. Forney.

No. 3. Standard Tests for Locomotives—(To investigate the practicability of establishing a standard system of tests to demonstrate the fuel and water consumption of locomotives. Also to ascertain the value of the steam engine indicator in locomotive tests).—J. N. Lauder, J. Davis Barnett, Albert Griggs, John D. Campbell, F. W. Dean.

No. 4. Compound Locomotives—(To investigate the relative economy of compound and simple locomotives; also the most valuable form of compound locomotive).—Geo. Gibbs, William H. Lewis, Pulaski Reed, James Meehan, T. W. Gentry, A. T. Woods.

Auxiliary Committee.—S. M. Vauclain, Baldwin Locomotive Works; Reuben Wells, Rogers; H. N. Sprague, Porter; A. J. Pitkin, Schenectady; Joseph Lythgoe, Rhode Island; F. J. Leigh, Canadian; D. A. Wightman, Pittsburg.

No. 5. Tests of Steel and Iron—(To investigate the critical temperature of steel and iron; also any other questions relating to steel and iron that the committee may consider of value).—Wm. Smith, J. N. Barr, A. W. Quackenbush, P. H. Peck, D. L. Barnes.

No. 6. Uniform Locomotive Performance Sheets—(To report on the practicability of establishing a system for recording the performance of locomotives that will fairly represent the work done).—Geo. F. Wilson, J. S. McCrum, John Player, James McNaughton, John A. Hill.

No. 7. Standard Bolts and Nuts—(To report on the best taper for bolts and the proper size of nuts, rough and finished. Also to report on accurate measuring gages).—Wm. Swanston, Wm. Garstang, T. W. Gentry, W. Lavery, A. Dolbeer, L. R. Pomeroy.

No. 8. Boilers for High Pressure Locomotives.—J. M. Boon, H. D. Gordon, J. S. Graham, J. H. McConnell, W. M. Marshall.

No. 9. Air Brake Standards and Inspection and Care of Air Brakes.—R. C. Blackall, G. W. Stevens, David Clark.

Committee on Subjects for Investigation—J. Davis Barnett, George Gibbs, Wm. Smith.

Candidates for the scholarships established by the Association at Stevens Institute will be examined on the week beginning Sept. 23, and should apply to the Secretary of the Association for a certificate of eligibility.

ANGUS SINCLAIR, *Secretary.*

New England Roadmasters' Association.—The ninth annual meeting of this association was called to order at the American House, Boston, Mass., at 2 P. M., Aug. 19, by President Mr. W E. CLARK. The meeting was opened with prayer by the chaplain, Mr. E. W. Horner. The minutes of the last year's meeting were then read, and the report of the secretary and treasurer, G. L. R. French, was received. The total receipts of the association for the year, including $249 brought forward from the previous year's account, was $916 80, and the total expenditures were $731.58, leaving $185.22 in the treasury. There are also outstanding debts amounting to about $40. Both the income and expenses of the association were increased during the year, largely on account of the increase in size and circulation of the annual report.

The roll was then called and showed the following members present: A. C. Bean, B. Braley, F. C. Clark, W. E. Clark, R. P. Collins, T. J. Dickey, J. W. Drew, W. F. Ellis, D. C. Garrison, H. N. Hammond, F. Holbrook, E. W. Horner, Wm. Hutchinson, R. Hyland, Chas. Lavoix, C. B. Lentell, Samuel Letchworth, E. Merrill, W. T. Mosher, Geo. Nevens, P. S. Perkins, G. K. Post, F. M. Post, J. W. Shanks, F. S. Sibbey, L. J. Spaulding, A. C. Stickney and Jas. M. Torr.

The following new members were then enrolled:

N. W. Aldrich (N. Y. & N. E.); E. O. Hathaway (Conn. River); John Hillcourse (Housatonic); Thos. Hogan (N. Y. & N. E.); L. N. Muzzey (B. & A.); John Sick (N. Y. & N. E.); J. J. Richmond (N. Y. & N. E.); John Walker (B. & M.).

The meeting then proceeded to ballot for officers, the following being elected: President, F. C. Clark (Housatonic); Vice-President, C. B. Lentell (B. & A.); Secretary and Treasurer, G. L. R. French (B. & M.); Chaplain, E. W. Horner, (C. Vt.). Executive Committee: W. E. Clark (V. V.); A. C. Stickney (B. & M.); E. K. Post (N. Y., N. H. & H.); F. Holbrook (N. Y., N. H. & H.), and the president, vice-president, and secretary and treasurer, *ex-officio.*

The reading of the reports of the various committees was then taken up. The following are the questions reported upon:

1. Track Joints; Trouble Experienced with Joints Now in Use and Points New Ones Should Cover.

2. Fences, Cattle Guards and Railway Crossings.

3. Best Method of Securing Rails to Ties Outside of Joints, Holding Gage on Curvrs; Spikes, Plates, etc.

4. To What Extent Can Wear of Engine Driving Wheel Tires be Allowed Before General Economy Demands their Repair.

5. Review of Previous Years' Questions.

The committee appointed to report upon the first question considered that the angle bar now commonly in use, was the best joint yet devised, although it was far from perfect. It considered the suspended joint preferable and recommended that the angle bar should have as few parts as possible, and be provided with proper means for fastening it to the ties. The want of good ballast and the lack of sufficient labor to keep the ties properly tamped and the bolts tight, was thought to be largely responsible for bad joints. It is necessary to have the angle bars a perfect fit and to have them straight. The committee also recommended the use of long rails, thus reducing the number of joints.

In the discussion which followed there was shown a great diversity of opinion, but it was generally agreed that poor ballast and lack of help were large factors in causing poor joints.

Mr. W. F. Ellis stated that he had collected a large amount of data regarding the forms of angle bars used by various railways in this country, and that there were hardly two roads using the same form, weight or size. Their lengths varied from 20 in. to 48 in., and the number of holes from 4 to 6. He thought that the variation was a matter which needed attention. He recommended a suspended joint, a rather short angle bar, about 24 in., head about 1 in. thick, neck ⅝ in. for inside and ¾ for outside, and foot not resting on ties. The ties should be about 18 in. apart. He also considered that the increase in the size of rail and weight of rolling stock demanded a bolt larger than ¾ in., but would recommend that caution be used in increasing its size, starting with ⅞ in.

Mr. R. P. Collins stated that he had had very good success with a steel angle bar weighing 40 lbs., with holes 5 in. c. to c., and suspended joints. He laid rails with ⅛ in. space between ends and in very cold weather doubled this space every third or fourth rail.

Mr. J. W. Drew preferred the suspended joint, but stated that his section bosses said they could keep the track in better repair with supported joints. He thought that ¾ in. bolts were large enough if made of good material, and also required his angle bars to be made of the best steel.

Mr. E. W. Horner considered that the bolt was the weak point in the present track joint, and thought that it should be strengthened either by using better material or a larger size.

Mr. J. W. Shanks stated that he found more imperfection in bolts and nuts than in any other part of the joint. The nuts were too thin, and the threads both in the nut and on the bolt were imperfectly cut. The great necessity was good ballast and plenty of help for repairs.

Mr. C. B. Lentell used a supported joint, and had no trouble in keeping it in repair.

The discussion was continued at the evening session as follows:

Mr. G. W. Bishop stated that his company had laid 13¾ miles of track with angle bar joints and that it worked well. The angle bars on his road commenced to break at the top and broke toward the bottom, the tie acting as a fulcrum of which the angle bar was the lever.

Mr. R. Hyland stated that he had used both supported and suspended joints, and that he preferred the suspended. He thought that the present ¾ in. bolts were large enough if made of good material.

Mr. Greer said that the angle bars used on his two-tie suspended joint broke and bent. He favored the suspended joint because with narrow ties a greater bearing surface was obtained with that joint than with the supported joint.

Mr. Chas. Lavoix, preferred supported joints with holes drilled through the foot of the angle bar.

Mr. Brennan regarded the suspended joint as preferable. He had never seen an angle bar strong enough for the rail.

Mr. R. P. Collins stated that he had used a 40-lb. angle bar, suspended joint, for two years and had discovered no weakness.

Mr. F. C. Clark then introduced the following resolutions, which were passed:

Resolved: That it is the opinion of this association that the suspended joint is superior to a joint supported by a tie.

That the present angle bar under 40 lbs. in weight requires more material in its construction, or to be of such shape as to afford greater vertical strength.

That a test of the present size of fish-bolts should be made to determine whether they are adequate in strength for the present heavy rail and rolling stock.

Adjournment was then taken until Thursday morning.

EXHIBITS.

The following is a list of the companies having exhibits of their various specialties at the convention:

Fairbanks, Morse & Co., section, push and velocipede cars; track and bridge jacks; Emerson rail bender, and samples of their pressed steel wheels recently placed on the market.—National Surface Guard Co., Chicago, National Surface railway cattle guard.—Standard Nut Lock Co., nut lock.—Keeler, Lyon & Co., Hobart, N. Y., a combined joint shoe, nut-lock and rail grip to prevent spreading and creeping of rails at curves.—Ramapo Iron Works, Hillburn, N. Y., Ross brake shoe.—Dilworth, Porter & Co., Pittsburg, Pa., Goldie spike, Goldie reversible spike tie-plate.—Pettibone, Mulliken & Co., Chicago, Jenne track jack, pattern 1891, Alkin's rail brace.—Weir Frog Co., Cincinnati, O., photographic views of Weir frog, blue prints of adjustable split switch, automatic spring switch stand, steel die-formed rail braces.—Bryant & Barbey, Boston, portable rail saw.—"Common-sense" tile surface cattle guard.—Morris Sellers & Co., Chicago, "Samson" splice bar.—National Nut Lock Washer Co., Newark, N. J., nut lock.—American Washer & Manufacturing Co., Newark, N. J., nut locks.—The Anderson rail joint.—Deane Steam Pump Co., Holyoke, Mass., Deane steam pump.—Fisher bridge rail joint.—Continuous Rail Joint Co. of America, Newark, N. J., continuous rail joint.—Geo. Nevens, Brunswick, Me., Nevens' improved flange scraper.—Morris, Sellers & Co., Greer's track spike.

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COMING TECHNICAL MEETINGS.

Engineers' Club of St. Louis.—Sept. 2. Secy., Arthur Thatcher, Room 801, Odd Fellows' Building.

Western Society of Engineers.—Sept. 2. Secy., J. W. Weston, 330 La Salle St., Chicago.

American Society of Civil Engineers.—Sept. 2. Secy., Francis Collingwood, 127 East 23d St., New York.

Engineers' Club of Minneapolis.—Sept. 3. Rooms, Public Library Bldg. Secy., F. W. Cappelen.

Association of Civil Engineers of Dallas.—Sept. 4. Secy., E. K. Smoot, 803 Commerce St.

Technical Society of the Pacific Coast.—Sept. 4. Secy., O. von Geldern, 819 Market St., San Francisco.

American Society of Swedish Engineers.—Sept. 5. At 250 Union St., Brooklyn, and 347 North 9th St., Philadelphia.

Northwest Railroad Club.—Sept. 5. Rooms, Union Station, St. Paul.

Civil Engineers' Society of St. Paul.—Sept. 7. Secy., C. L. Annan.

Engineers' Club of Kansas City.—Sept. 7. Rooms, Baird Building. Secy., H. Goldmark.

National Electric Light Association.—Annual Convention, Sept. 7-12, Montreal, Que.

Atlanta Society of Civil Engineers.—Sept. 8. Secy., Parker N. Black, Room 39, Capitol Block.

Denver Society of Civil Engineers.—Sept. 8. "Municipal Engineering." Secy., Geo. R. Angell.

Civil Engineers' Association of Kansas.—Sept. 9. Secy., J. C. Herring, Wichita, Kan.

Master Car and Locomotive Painters' Association.—Annual Convention, Sept. 9, Washington, D. C. Secy., Robert McKeon, Kent, O.

New England Railroad Club.—Sept. 9. Rooms, United States Hotel, Boston.

American Roadmasters' Association.—Annual Convention, Minneapolis, Sept. 10, 11. Secy., J. P. Ramsey, Muncie, Ind.

Civil Engineers' Club of Cleveland.—Sept. 11. Secy., A. H. Porter, 50 Euclid Ave.

Northwestern Track and Bridge Association.—Sept. 11. Rooms, Union Station, St. Paul.

Western Railway Club.—Sept. 15. Rooms, Rookery Building, Chicago.

Engineers' Society of Western Pennsylvania.—Sept. 15. Secy., J. H. Harlow, Pittsburg, Pa.

Engineers' Club of Cincinnati.—Sept. 17. Secy., J. F. Wilson.

New York Railroad Club.—Sept. 17. Rooms, Gilsey House.

Scandinavian Engineering Society of Chicago.—Sept. 17. Secy., T. G. Philfeldt, 118 Adams St.

Montana Society of Civil Engineers.—Sept. 19. Helena.

AN epidemic of fatal railway accidents seems unfortunately, to have started in Europe. There were the fatal bridge accident of June 16, at Moenchenstein; the collisions at the Northern Ry. terminus, Paris, July 12, and at St. Mandé, near Paris, July 29, and now the one near Berne, on Aug. 16. These four accidents within two months cost the lives of over 140 people and seriously injured several hundred more. The fact that two of these accidents occurred near together and on the same railway system, the Jura-Simplon, makes it unfortunate for that road as a route for travel; and in both cases the accident was due to causes easily preventable. One arose from a defective bridge, and the other from gross negligence in transmitting signals. This latter was not to be expected in a country where railway employés are supposed to be under the strictest military discipline, and are usually recruited from the ranks of soldiers who have seen service and passed years under drill. Something must be wrong with the methods and personnel of the Swiss road, and it will probably be well for Continental railway managers generally to overhaul their bridges and their methods of management; otherwise they will lose the felicity of pointing to America as the land famed above all others for its "railway horrors."

A GREAT many people have become well persuaded in their own minds that the electric motor is soon to supplant the steam locomotive as the tractive agent on ordinary railways. It would be foolish to say that this will never come to pass, for no one knows what revolutions may yet be worked by the discovery of new methods for the production and distribution of the electric current. At present, however, these are possibilities of the future only; and comparing the records of experience on electric railways with those on steam railways, it is difficult to see how the electric motor can compete with the steam locomotive, except under peculiar circumstances which favor the former rather than the latter.

The West End Railway may fairly be taken as a sample of first-class electric railway practice at the present day. The company operates 260 miles of street railway in and about Boston, of which 200 miles are operated by horse and 60 miles by electric motors. Elsewhere we have noted its report for the month of June, 1891, showing that the operating expenses of the electric cars were a little over 20 cents per car mile, and the earnings were nearly 43 cents. This does not include, of course, the interest on the cost of the road, the capital invested in electric plant, rolling stock, etc. In the following table these figures are compared with the earnings and operating expenses per car mile on a number of steam railway lines as given in the report of the statistician to the Interstate Commerce Commission for the year ending June 30, '89:

Per Car Mile or Passenger Train Mile.

	Ave. earnings.	Ave. operating expenses.
West End Ry., June, '91:		
Electric cars	$0.4271	$0.2037
Horse cars	0.3685	0.2458
All rys. of U. S., year ending June 30, '89	1.0628	0.5743
Boston, Winthrop & Shore	0.5411	0.1875
Cairo, Vincennes & Chicago	0.6255	0.2653
Cent. R. R. & Bank. Co. of Ga.	0.8312	0.3705
Cleve. & Canton	0.514"	0.2500
Dayton, Fort Wayne & Chic.	0.3811	0.2721
Del. & Hud. Canal Co.	1.0853	0.4253
Del., Lack. & Wn.	0.9775	0.3069
Current River	0.9743	0.1303
Kan. Cy. & Pacific	0.2224	0.0732
Ohio River R. R.	0.5568	0.2130
Pennsylvania R. R.	1.3651	0.6414
Pennsylvania Co.	1.0128	0.4177
Pittsburg, Marion & Chicago	0.4874	0.0958
Talladega & Coosa Valley	0.3348	0.1503
Zanesville & Ohio River	0.5504	0.1560

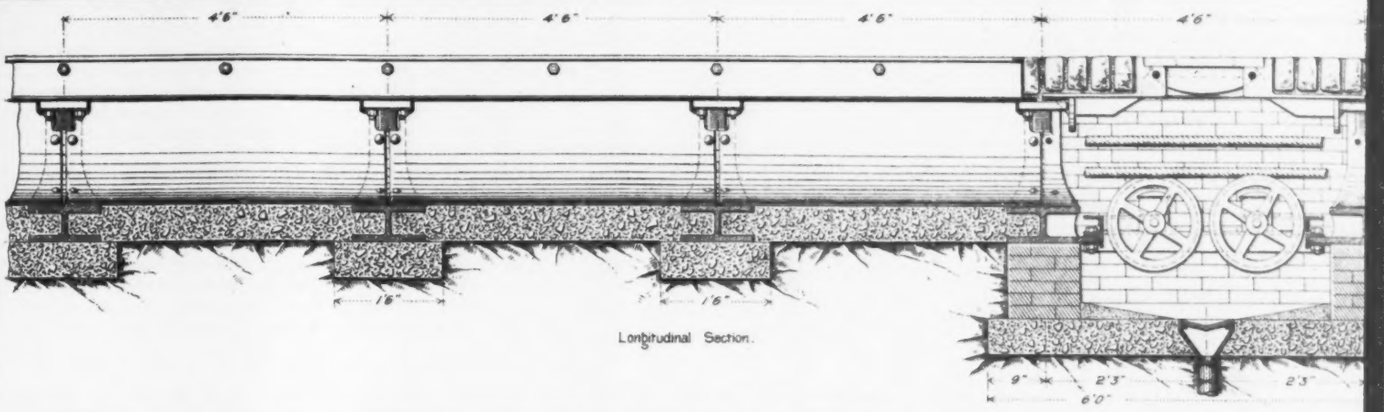
PROBABLY there is no one so daft on the subject of electric traction as to claim that it would take less capital to equip an ordinary railway for operation by electricity than to equip it for operation by steam locomotives. The roadbed and track cost as much for one as for the other, and the cost of central stations and the line wire would far outweigh any possible saving in the cost of electric locomotives as compared with steam. The advocates of electric traction, therefore, base their claims on the ground that the operating expenses will be less than with the steam locomotive. The above table shows how weak ground this claim rests on. It shows that roads of very light traffic, but in many cases of considerable length, are already running their passenger trains at a less cost per mile than the West End Ry. can run its cars for in the streets of Boston. How can such a road gain anything by adopting electric traction? The operating expenses would inevitably increase over those recorded above for the West End Ry., and the capital required for establishing the electric plant would be so great as to make the construction of the road in the first place quite out of the question.

Another class of roads included in the above table are those carrying a very heavy traffic, of which the Lackawanna and the Pennsylvania are examples. The cost of running a passenger train one mile on the Lackawanna is 1½ times and on the Pennsylvania about 3 times what it costs to run an electric car, weighing loaded not over 10 tons, a mile through the streets of Boston. Remembering the far greater weight and speed of the passenger train, it is difficult to believe that the passenger traffic of a road like the Pennsylvania or the Lackawanna could be moved as cheaply by electricity as by steam, even if the enormously greater first cost of the electric system were not in the way.

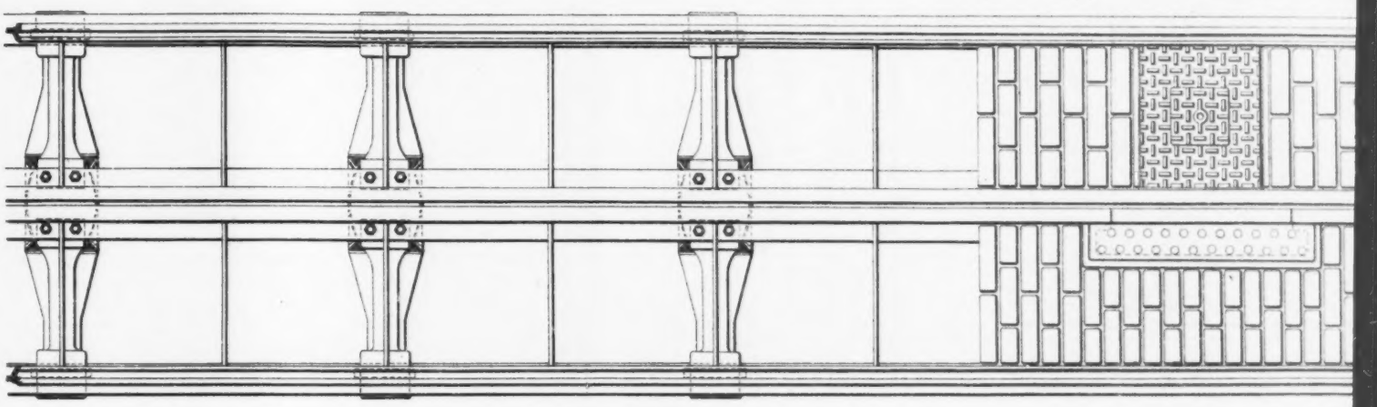
The proper field of electric traction in its present stage of development, then, seems to be on railways in street and suburban service where traffic is concentrated, but where frequent service is a necessity. It is as manifestly suited for this as it is unsuited for hauling heavy Pullman trains across the continent, or for running the two or three daily trains which constitute the passenger service on a large mileage of American railway lines.

WE notice a little item in the *Sydney Pioneer*, concerning the Point Turner navy yard site, on the Pacific Coast, that causes a little surprise. The site for this dry-dock was carefully studied by two Presidential Commissions of line officers of the United States Navy; that of Capt. MAHAN in 1889, and of Capt. SELFRIDGE in 1890. After much discussion of detail a site was fixed upon, the land purchased and arrangements perfected for commencing an important engineering work. In the eyes of the line officers concerned, the services of a civil engineer were apparently not deemed essential until the hole was to be dug; but when the civil engineer did come upon the ground, some important discoveries were made. The chief of these was the fact that a bed of quick-sand of unknown depth and extent was found to exist on the proposed site, and the engineer is now seeking a more suitable foundation "about one mile further down the beach," says the *Pioneer*. The moral of this sequence of events is one that we have frequently pointed out before, and that is, that a board of competent civil engineers is as essential a factor in naval as in civil circles in the performance of engineering duty. It is odd, to say the least, that the U. S. Navy Department should have in its service a corps of specially trained civil engineers, and yet detail line officers to perform a duty that most distinctly belongs not to them, but to the engineers. In this particular case it is evident that valuable time and considerable money have been wasted by a course that, in civil life, would have been considered the reverse of wise.

PERHAPS there is no piece of information which the Census office has yet made public which has been more welcome knowledge and at the same time has been more unexpected by the people at large, than its figures of the increase of the white

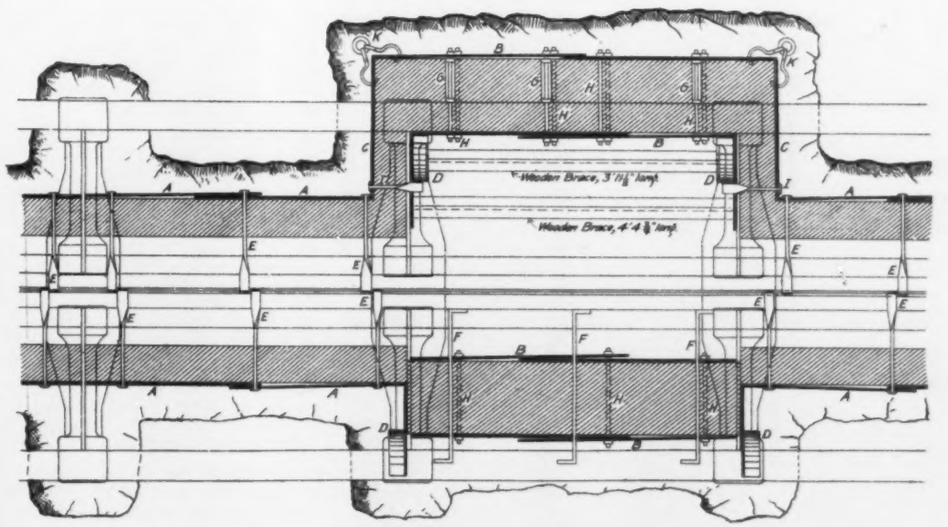


Longitudinal Section.

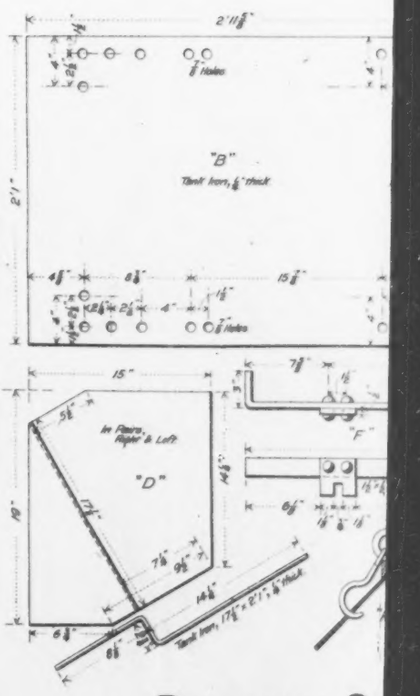


Plan.

CONDUIT, SHEAVE PIT & GRIP HATCH.

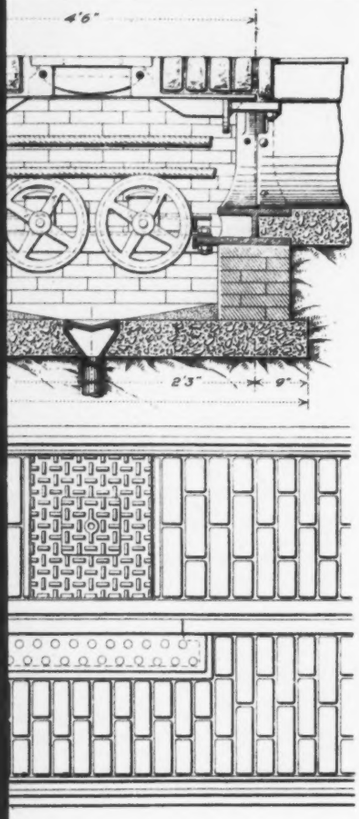


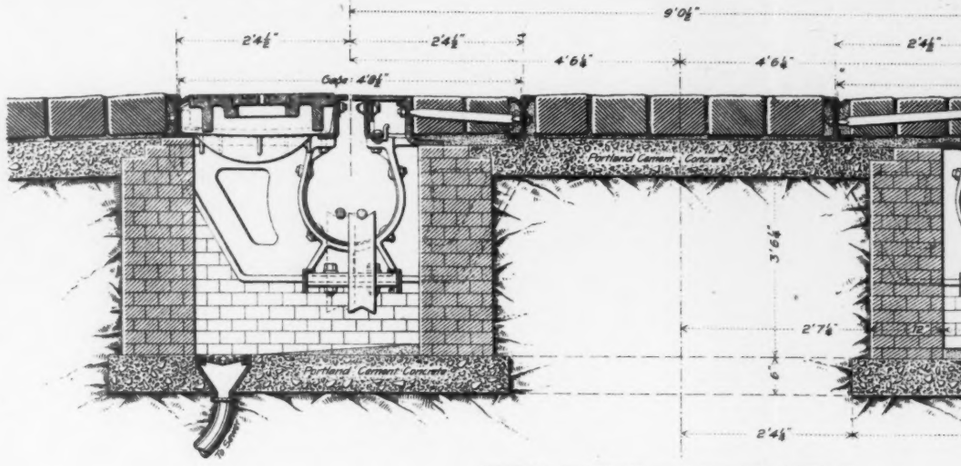
ARRANGEMENT OF CONCRETE FORMS.



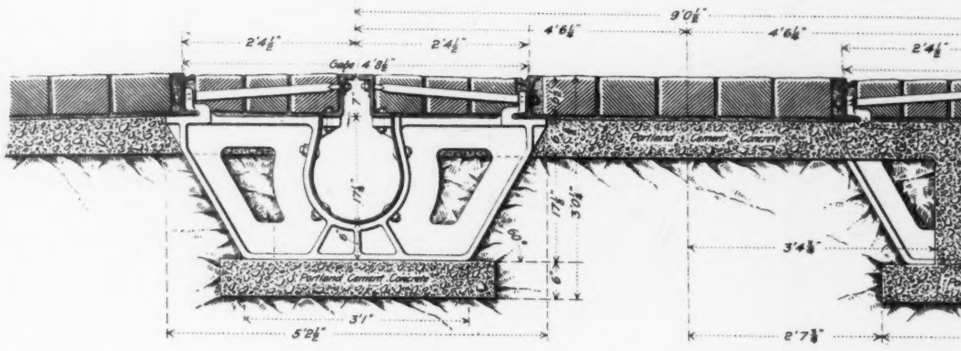
BROADWAY CA

JOHN D. CRIMMINS, CONTRACTOR.

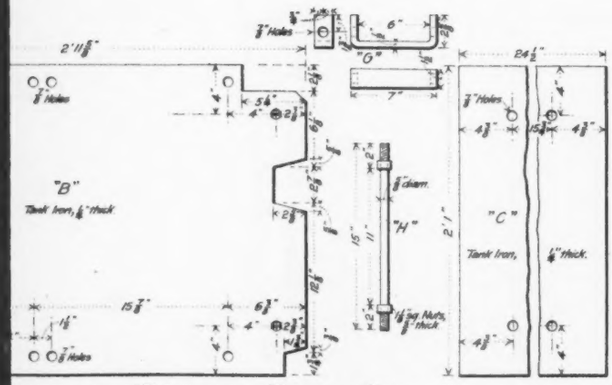


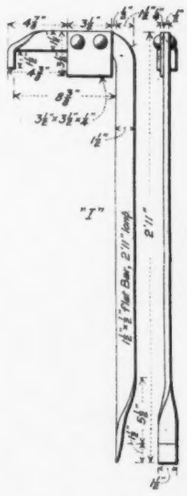


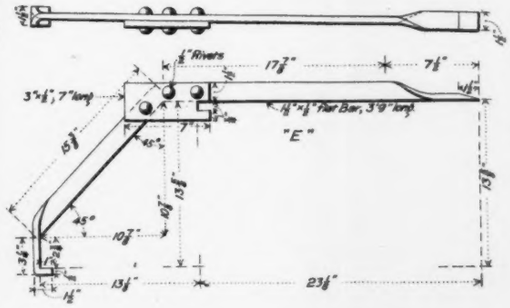
SECTION AT SHEAVE PITS AND GRIP HATCHES.

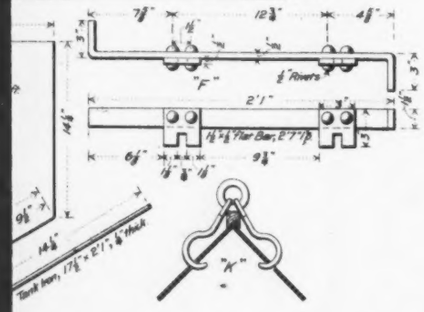


SECTION THROUGH ROADBED BETWEEN PULLEY PITS.









Material for one Section.

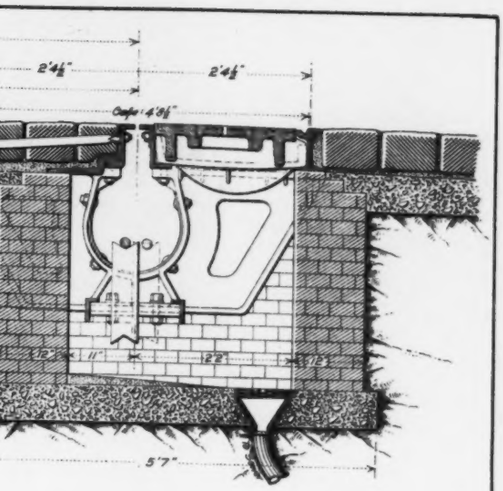
24 Conduit Plates	(A)	2'5⅝" × 17" × ¼"	35.5 lbs.
8 Pit Side "	(B)	2'11⅝" × 2'1" × ¼"	84.9 "
2 " End "	(C)	2'0½" × 2'1" × ¼"	42.0 "
4 Yoke " (Right & Left)	(D)	2'1" × 17⅞" × ¼"	30.5 "
36 Conduit Braces	(E)	3'9" × 1½" × ¼"	9.4 "
36 Clips for do.	(=)	7" × 3" × ⅜"	2.9 "
3 Cross Braces	(F)	2'7" × 1½" × ⅜"	6.7 "
6 Clips for do.	(=)	3" × 3" × ⅜"	1.3 "
3 Distance Pieces	(G)	12⅝" × 1½" × ½"	2.7 "
11 Bolts, 2 Nuts each	(H)	15" × ⅝"	1.7 "
2 End Braces	(I)	2'11" × 1½" × ¼"	7.3 "
2 Clips for do.	(=)	3½" × 3½" × ⅜"	1 lb.
4 Sister Hooks	(K)	6" long	1 "

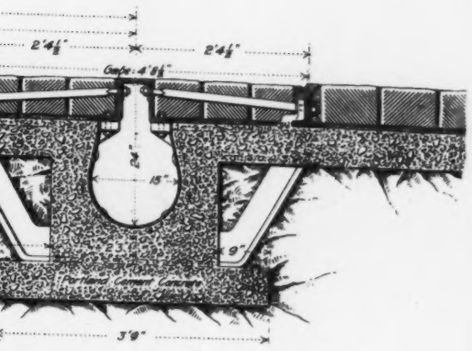
CONCRETE FORMS FOR CONDUIT & MANHOLE WALLS.

BROADWAY CABLE ROAD, NEW YORK.

MMINS, CONTRACTOR.

GEORGE W. McNULTY, ENGINEER.





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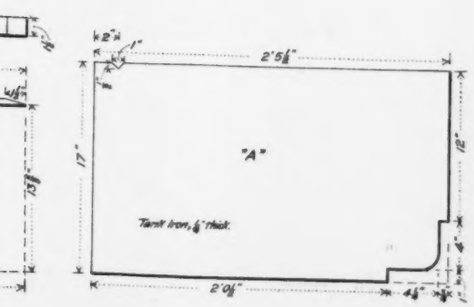

5 lbs.
9 "
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5 "
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7 "
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CHAS. HART & SONS, LITH., 39 VESEY STREET, N. Y.

and colored population of the South. The Tenth Census of the United States showed that in the decade from 1870 to 1880 the colored population, in spite of the multitude of disadvantages under which it labored, had increased nearly 35 per cent., while the white population, which had grown through the influx of hundreds of thousands of emigrants from foreign lands, had increased less than 30 per cent. The census authorities claimed at the time that this apparent enormous increase in the colored population was in reality due to large omissions in the census of 1870; but the popular mind has placed more confidence in the figures than in the statistician's analysis of them, and the belief has been very general that the colored population of the South was increasing much faster than the white. Had this rate of rapid increase actually existed among the colored people, it would have made the race question in the South a very serious one, a fact which the best friends of the colored race have fully recognized. The eleventh census statistics of population, however, show that the colored population is increasing at no such abnormal rate as has been supposed. The total increase in colored population during the past decade in the South Atlantic and South Central States, with Missouri and Kansas, was at the rate of 13.9 per cent., while the white population in these States increased at the rate of 24.67 per cent., or nearly twice as rapidly as the colored population. Thus during the past decade the colored race has not held its own against the white in a region where the climate and conditions are, of all those which the country affords, the best suited to its development. Only three states, South Carolina, Mississippi and Louisiana, now have a colored population in excess of the white. Of these three states, only Mississippi showed a greater percentage of increase of colored than of white population in the past decade, her white population increasing 12.58 per cent. and her colored population 14.98 per cent.

THE collision which occurred on the Philadelphia & Reading R. R. at Egg Harbor, N. J., on Aug. 15, and which is described on our engineering news page, calls for editorial comment. A northbound freight train was being switched onto the southbound track to let a northbound passenger train pass. A southbound express was about due, and the natural result was a serious collision. In the press dispatches the cause of the accident is attributed to the failure of the air brakes on the passenger train, a defect having developed after the brakes had been carefully examined at Camden and found to be in good order. The engine driver, however, in his statement to a reporter, said:

"When I came to the top of the hill beyond the station I saw the freight, but in the twilight and gathering darkness I could not tell at that distance that she was on the southbound track. I kept watching her, and when I got into the hollow I saw that she was on my line. I whistled three times for her to hold back, for I was getting ready then to slow up for Egg Harbor depot. The engineer of the freight paid no attention and kept coming on, and when I reached the culvert and saw that he was disregarding my signals, I threw the brakes on full and yelled to my fireman to jump. If the brakes had operated as they should, the collision would not have occurred."

It is quite probable that in his uncertainty the driver of the passenger train let his train run further than he thought before he applied the brakes. While it is possible that a defect in the brake apparatus might have added to the seriousness of the results of the collision, that is a secondary matter, and it is becoming a very much too common practice in cases of accident to make the air brake a scapegoat to carry the responsibility properly resting upon the officers of the railway. The accident is claimed to have been "one of those purely accidental occurrences that no amount of human ingenuity and foresight could successfully guard against." Such an accident could have been guarded against if human ingenuity and foresight had provided a sidetrack, and had forbidden the use of a main track as a sidetrack, especially without any protection by signal equipment and at a time when a train was known to be due. It does not appear that the railway officers can escape censure by either of these excuses.

The Resources and Growth of the "Pacific Slope" of the United States.

The Bay of San Francisco, which may be taken as the commercial center of that section of our country lying west of the Rocky Mountains and popularly known as the "Pacific Slope," was not discovered until about 120 years ago; and prior to 1848 the whole region comprised in this "slope" was only occupied by a few scattered ranches and Spanish missions, with their priests and Indian converts. At the close of the Mexican war, which gave the United States undisputed possession of this territory, the whole white population scarcely exceeded 12,000, and had not Colonel SUTTER found gold in his mill race, the growth of this remote country would probably have been very slow as compared with other sections of the United States east of the Mississippi River.

What has happened since then is graphically set forth in the last report of the United States Treasury Department on the development and progress of the States and Territories of Alaska, Arizona, California, Idaho, Nevada, Oregon, Utah and Washington, which now cover the region west of the Rocky Mountains. The energy and enterprise of the people of this section of our broad country has been almost phenomenal in material results, and are well worth noting at considerable length.

Commencing with its area and history we find that the five states and three territories named cover 1,297,235 square miles, or a little more than one-third of the total area of the United States. But excluding Alaska in this count, we have only 719,845 square miles, or about one-fourth of the area of the United States in the remaining States and Territories. From Mexico to the British possessions on the north, the distance is about 1,200 miles, and the east and west axis is about 850 miles. A large part of this territory was acquired from Mexico by the treaty of Feb. 2, 1848, in which the United States stipulated to pay $15,000,000, or what was then considered the exorbitant sum of about seven cents per acre for the area covered by this treaty. The country was supposed to be sterile and as having little value outside of a comparatively few known mineral deposits. As the United States paid but two cents per acre, in 1803, for the Louisiana Purchase, the objections were seemingly well founded; but the wisdom of both purchases has since been very forcibly demonstrated.

It is interesting to here recapitulate some of these early purchases of territory by the United States. The first of these was Louisiana, in 1803, embracing the valley of the Mississippi and a large part of the Northwest. We paid France $15,000,000 for it. In 1819 Florida was bought from Spain for about $3,000,000; in 1845, Texas was acquired without purchase, but in 1850, the sum of $12,750,000 was granted to that State by the general government. In 1848, California, as mentioned, cost $15,000,000 for a territory covering besides that State, Arizona, Nevada, Utah and parts of New Mexico and Colorado. In 1854, Arizona cost the further sum of $10,000,000; and in 1867, we acquired nearly 600,000 sq. miles of territory in Alaska for the sum of $7,200,000. It is not necessary to figure out the commercial and national gain from these purchases; but we can say for Alaska, the latest of all our bargains, that the revenues of the United States from the seal fisheries and customs to date, have already amounted to $6,040,352; a sum closely approximating the total purchase money.

Taking up Alaska first, as the latest and least known of our acquisitions, few people realize that, owing to the warm Japanese current, or the Pacific Gulf Stream, passing south along its shores, the climate of the coast is milder than the Hudson Bay region, or corresponding latitudes on the Atlantic coast. In addition to the effect of these oceanic currents, the configuration of the northwest coast and the Pacific Slope, backed by lofty mountain ranges, is such as to intercept the warm atmospheric currents from the sea, and keep back the icy blizzards from the far North. The records of the Signal Bureau show that at Sitka in Lat. 57° 3′ N., the lowest temperature, in the years 1881-'87, was 3°, and the highest temperature 79° Fahr. The mean summer temperature is about 53°, and the mean winter temperature 33°, Fahr. Surprising as it may seem, the winters of Sitka are really milder than those of Stockholm, St. Petersburg, Moscow, Berlin, Stuttgart and Vienna; and more moderate than those of Boston, Portland or Albany, in the United States. As showing the material progress of Alaska, it is estimated that a total of $4,100,000 is now invested in various enterprises in that country, and the exports for 1889 amounted in value to $9,840,730; salmon, seal-skins, gold and whalebone, figuring therein in the order given and making up two-thirds of the total. The products of one year are thus far in excess of the sum of money paid for the purchase of the territory only 24 years ago. It is interesting to note, in passing, that Cape Prince of Wales, the most westerly point of Alaska, is 1,650 miles west of the meridian of San Francisco, and distant therefrom 2,720 miles by the most direct route.

The whole population of the Pacific States and Territories, in 1890, was 2,299,287; California alone containing a little more than half of this total, and Oregon, Utah and Washington numbering 313,767, 207,905 and 349,390 respectively. Starting with a total for all this region of 117,271, the average increase of population between 1850 and 1860 was at the rate of 319%; between 1860 and 1870, 83%; 1870 to 1880, 59%, and 1880 to 1890, 61%. When it is considered that the average increase of all the States and Territories, between 1880 and 1890, was 24.57%, the full meaning of the growth in the Pacific States can be better appreciated.

When we seek for the cause of the remarkable progress made in 40 years on the Pacific Coast, we find it in the almost unparalleled mineral wealth that first attracted the multitude to this coast in the early days of its occupation by the United States, and in the wealth of its forests and fisheries and the prodigal yield of its fields. Of gold and silver, in the period 1848-89, California alone has added the enormous sum of $1,249,961,343 to the stock of precious metals; and the totals for these several States and Territories is—$1,373,472,468 in gold, and $241,142,624 in silver; a grand total of $1,614,615,092 added to the wealth of the world in 40 years. Of the total production of gold and silver in the United States, between 1881 and 1889, 62.1% of gold and 42% of all the silver, and 51.5% of the total of both, came from the Pacific States. The total production of gold in these 9 years, for the whole country, was $293,934,500; and of this amount the Pacific Slope furnished $194,396,468. The total production of silver in the same period was valued at $464,732,430, and of this the Pacific group supplied $196,487,624. Thus out of the combined product of gold and silver in the United States, for 9 years, $758,666,930, or more than half came from west of the Rocky Mountains.

While this modern El Dorado was doubtless the inspiring cause for the early rush to the shores of the Pacific, men soon found that there were other sources of wealth in that rich land than those that lay hidden in the bowels of the earth. They began to cut the timber and till the land; and now from San Diego to Puget Sound the fertile valleys and rich prairies are producing grain

and fruit of a value far exceeding that of the gold and silver that first made California famous. As showing both the extent to which land has been devoted to agriculture and the wealth that still lies undeveloped in this direction, it is only necessary to say that in 30 years intervening between 1850 and 1880, the area of improved land increased from 181,644 acres to 14,366,695 acres. And of unimproved land contained within the farms of this group of States and Territories there are 9,509,937 acres. Taking the wheat crop alone, for the 5 years 1885-89, we find that its value was $211,344,881, as compared with $213,536,624, the total product of gold and silver for the same period. In California alone, during these 5 years, the wheat crop exceeded the value of both gold and silver by $47,155,401; in Oregon the wheat was worth $44,256,433 more than the gold and silver for that State, and in Washington the excess for wheat was $26,626,261. But in Arizona, Idaho, Nevada and Utah the value of gold and silver was far ahead of that of grain.

If we add to wheat some of the other products of this group, the almost fabulous production of gold and silver sinks further still out of sight, in comparison. Thus for the one year of 1889, the wheat crop of California was worth $30,646,844; of cattle and sheep slaughtered, $32,000,000, and for fruit produced, $16,000,000. This is an aggregate of $78,646,844, as compared with $14,034,343, the total value of the gold and silver produced in that State for the year, or over five times as much. And when we take the 22 years, 1868-1889, for California alone, we find that while gold and silver produced the enormous sum of $399,161,343, the wheat production of the same period was 647,596,260 bushels, valued at $628,040,840, or an excess of value in favor of the wheat crop of $228,879,467. In this same 22 years the hay crop of California was worth another $257,696,362. These are enormous figures, but a similar story can be told for the States of Oregon and Washington. For the years 1885 to 1889, inclusive, the exports of wheat and wheat flour from the ports and customs districts of the Pacific Slope varied from 18.79 to 36.52% of the total exports from the United States, and averaged 25.42% for the years mentioned. The aggregate value of these exports for this time was $166,970,683. England and Ireland took over 20,000,000 bushels out of an aggregate of 22,824,416 bushels of wheat alone exported from these Pacific ports in the year ending June 30, 1890.

The wonderful fisheries on this coast are another source of great profit, and the means of employing many men and vessels. For the year ending June 30, 1890, the foreign export of canned salmon amounted to 28,110,308 lbs., valued at $3,165,058; and the total catch of the Arctic whaling fleet, reporting at San Francisco, for the 16 years, 1874 1889, amounted to 290,599 barrels of oil, 3,913,638 lbs. of whalebone and 266,660 lbs. of ivory.

The lumber interest, vast as it is, may still be regarded as in its infancy, for a large portion of the virgin forest still lies within the unsurveyed government land and is not available, and much that is opened for development still lies beyond the lines of water or land transportation. Leaving out Alaska, the Department of Agriculture, in 1889, estimated that out of the total area of the other Pacific States and Territories, or 460,700,800 acres, 86,234,000 acres, or 18.7% was in forest. The timber from this region is of the finest quality, and the principal and most valuable for home and foreign markets are the Douglas spruce or red fir, bull-pine, redwood, cedar, white pine and western hemlock. The redwood belt extends from the Bay of Monterey nearly to the Oregon boundary, and the dense coniferous forests of Oregon and Washington cover 32.8 and 41.6 per cent., respectively, of the areas of these States. Nevada has the least per cent. (2.8) of timber of any State, and Utah has but 7.8 per cent. of its area in forests. The immense forests of Alaska, mainly of spruce, hemlock and red cedar, are not yet available beyond the home supply, as all the lands still belong to the Government. The Forestry Division of the Department of Agriculture estimates the output of lumber for 1890, for the Pacific group, at 3,474,000,000 ft. B. M. of sawed lumber and 1,659,600,000 shingles. The value of the total exports of lumber during the 6 years 1885 to 1890, amounted to $12,889,622.

In sheep and wool products California is only second to Texas, having in 1890 4,035,120 sheep, and a wool clip of 26,228,280 lbs. And the total for all these States for the same year was 11,580,657 sheep and a wool clip of 79,072,383 lbs. This amounts to 26.12% of all the sheep and 29.42% of the total wool product for the United States in 1890.

As might be expected under the conditions here outlined, the accumulated wealth in real and personal property on the Pacific Slope is in proportion to its vast resources. Without going into detail, it is sufficient to say that the estimated true value of real estate and personal property in 1890 was $2,957,607,217. Nearly all of this has been accumulated in 20 years, or since 1870; for the gain in values given in the census for the period 1870-90 was $2,196,431,625, and of course this only refers to the wealth that has remained in this region. The greatest gain has naturally been in California, where real and personal property has advanced in value from $22,161,872 in 1850 to $1,832,955,323 in 1890.

The transcontinental railways have played a most important part in the development of the Pacific Coast; not only in tying together the valley of the Mississippi and the region beyond the Rocky Mountains, but in searching out and stimulating all manner of industries and resources, and providing transportation for the products of the more remote sections. The five great trunk lines and their numberless branches have opened up this country to the markets of the world, without which markets much of the energy and capital that now make these States and Territories powerful and rich, would have been wasted, or rather not called forth at all. The transformation that has here taken place in so short a period is all the more wonderful when we remember that 30 years ago there were but 23 miles of railway on the Pacific Coast, and in 1865 less than 3,000 miles of railway, all told, west of the Mississippi River, where there are now 75,000 miles, according to the latest figures.

The first of these transcontinental lines, the Union Pacific, was chartered by act of Congress, July 1, 1862; the Central Pacific, connecting with it and forming a continuous line from Omaha to San Francisco, was chartered on June 28, 1861, and this first through line was opened to traffic on May 10, 1869, only 22 years ago. The other lines and branches followed rapidly and railways began to spread over the territory west of the mountains, until the 23 miles, of 1860, had grown to 12,181 miles in 1890. The cost of the railways in the Pacific group was set down, for 1889, as amounting to $574,104,988, or about $47,000 per mile. The cost and equipment of the entire system of transcontinental lines, while difficult to figure out, will undoubtedly aggregate about $900,000,000 for the construction of the 23,000 miles of railway included in the five separate systems known as—The Canadian Pacific, Northern Pacific, Union Pacific, Atchison, Topeka & Santa Fé and the Southern Pacific railways. The Treasury report quoted estimates the total cost of all these roads and their equipment at $1,300,000,000, which is probably as close to the true figures as these can be ascertained. In 1889 these five systems carried 28,909,127 passengers; moved 6,658,496,099 tons of freight one mile; and earned $36,891,752 from passengers and $88,463,941 from freight carried. The total gross earnings were $136,963,286, operating expenses $90,086,645, and the net earnings were $46.876,639. It is understood that these figures embrace the traffic not only of the main lines, but that of all the numerous branches and the local and through traffic. Notwithstanding the enormous capital invested, the average freight rates per ton mile, as given in Poor's Manual for 1889, have been continually reduced since 1880, and now stand as follows: Atchison, Topeka & Sante Fé, 1.289 cts.; Canadian Pacific, 0.915 cts.; Northern Pacific, 1.43 cts.; Southern Pacific, 1.254 cts.; Union Pacific, 1.37 cts.; and the average is 1¼ cts. per ton mile for the five systems. The reduction in freight rates from 1880 to 1885 was 46.8%, and from 1885 to 1889, 25%, or a reduction of 57.7% between 1880 and 1889. As showing the effect of these roads upon other and older lines of traffic, it may be mentioned that there has been a decrease in the total domestic trade by way of the Isthmus of Panama from $18,273,407 in 1870, to $3,058,509 in 1890.

By delving further through the 1,200 printed pages of this latest report on the internal commerce of the Pacific States and Territories, many other items of interest could be gathered and added. But we think that enough has been presented to show the wonderful resources, energy and wealth of this favored portion of the United States. All that has been done there is the work of but one generation; and as a consequence the work still remaining to be done, in uncovering and bringing to the markets of the world the yet untouched wealth of the Pacific Coast, is as broad in its proportions as its value is beyond even estimate.

CORRESPONDENCE.

A Swinging Railway Car.

ANDERSON, S. C., Aug. 1, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: From your criticisms of my patented improvements in the construction of railway cars in your issue of July 11, I do not think you have exactly caught on to my idea. It is doubtless the fault of my specifications.

The car within the frame was never intended to "swing like a pendulum," and if by the proper construction such motion cannot be prevented, I am free to admit that the invention is a failure.

The car, however, will not be hung within the frame like a pendulum in a clock, but the connection between it and the frame will be as firm as possible, there being barely sufficient play for the great weight of the car to produce motion.

Again, in cars as built at present, the trucks are connected with the floor of the car, upon which rests the seats or berths. Consequently, the many jarring motions caused by irregularities in the track or otherwise are directly transmitted to the seats or berths, to the discomfort of the passengers. With my improvement, these jarring motions, in order to reach the seats, would have to traverse the sides of the frame, pass through the connecting points, made elastic by springs, then down the sides of the car to the floor, which process is enough to destroy much of, if not the entire initial force of these motions.

In these days there is scarcely a limit to cost, where the comfort of the traveling public is the end to be attained, and I do not believe this will prove a serious objection to the improvement. Nor can I see how the danger in time of accidents would be increased. In fact the frame might be so constructed of proper materials, with a sufficient number of buffers placed on the inner sides and ends, to form quite a protection to the car in moderately severe accidents.

The object of my improvement is to construct a car that will be free from the swaying and jarring motions, so objectionable in cars as built at present, especially in sleeping and dining cars. It is an improvement that is certainly needed, and if my invention does not accomplish it some other device will be invented before many years that will.

WM. C. WHITNER.

A New Form of Cement Specification.

PHILADELPHIA, Aug. 17, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR:—Referring to a letter written you regarding the cement used by the East Jersey Water Co. on their system of dams, I would specially like to call your attention to the cement contract for this particular work, as it

offers a novelty in the method of purchasing cement in this country.

The usual method of purchasing cement in the United States is to require by the specification that the cement shall be "satisfactory to the engineer," or if any special requirements are desired, to specify the tensile strain of the cement neat in 24 hours and 7 days. In rare cases a test is prescribed for the cement with 2 parts sand.

In the request for bids for the cement for the East Jersey Water Co., the specification sent out stated the amount of cement that would be required, and provided that the cement should be tested for free lime and that it should weigh so much per cubic foot. All the other elements of the quality of the cement, such as fineness, time of setting and tensile strength, were left in blank, leaving it to the manufacturer to specify what he was ready to deliver for a given price. The effect of this novel method of purchasing cement was to put the manufacturer in position to be paid for whatever he was ready to do in the way of extra fine grinding and the consequent increased sand-carrying qualities of his cement.

As a result of the various bids for the work in question the contract was awarded to the American Cement Co. for its "Improved Union" cement, and this cement has been supplied upon the work for two years past. The bid for this season's work was based upon a guarantee that a mortar of 1 part "Improved Union" cement and 3 parts of sand would give a tensile strength greater than an ordinary Rosendale mortar of 1 part cement and 2 parts sand.

The cement in question, which is practically the standard on the Pennsylvania, Reading, Lehigh Valley and Baltimore & Ohio R. R.'s, was sold at a price but little higher than the better grades of Rosendale cement, and owes its great strength to the fact that it is an artificial mixture of the natural light burnt cement of the Lehigh cement district, and the well known "Giant" brand of American Portland cement, manufactured at the same works, at Egypt, Lehigh Co., Pa. The 2 to 1 sand mortar of this grade of cement was guaranteed to stand a tensile strain at 7 days of over 40 lbs. per sq. in., while the 3 to 1 sand mortar was guaranteed to stand a tensile strain of over 25 lbs. per sq. in., also at 7 days. For purposes of comparison, it may be stated that the last large government contract for the building of the Library of Congress required of magnesian cements only 15 lbs. in 2 to 1 sand mortars, while of the lime cement it required 25 lbs. in 2 to 1 sand mortars at 7 days, while the New York Aqueduct specification for the same grade of cement required 25 lbs. for 2 to 1 sand mortar. The proportions in the concrete mixture on the East Jersey Water Co.'s dam of 1 part cement, 3 parts sand and 4 parts broken stone, as shown by your very interesting article on the subject (ENGINEERING NEWS, Aug. 8, 1891, p. 113), indicate that the cement has been used almost in the same proportions as a Portland cement would be used, and the results of the tests made by the East Jersey Water Co.'s engineers show that the specifications and tests guaranteed by the manufacturers have largely exceeded the guarantee, in 24 hours neat showing 130 lbs. as against 70 lbs., guarantee, and at long time tests, that the mortar mixtures and concrete mixtures show a strength almost equal to Portland cement, and nearly double the strength guaranteed.

The fact that by a proper co-operation between engineers and manufacturers, whereby the extra cost of fine grinding will be paid for when the cement shows extra sand-carrying qualties, a cement of this character can be obtained at a low cost, is a most important one to all doing large work, as it will enable in many cases large work to be done at a minimum of cost, by the use of semi-Portland cements, such as the Improved Union, in lieu of the more expensive Portland cement.

R. W. LESLEY,
Treasurer American Cement Co.

[As will be seen from the above, competition was invited both in quality of cement to be furnished and price for the same, instead of in the one element of price. This is certainly a novel and interesting feature in cement specifications, and seems to have met with excellent results. It has the great merit of stimulating the manufacturer to produce the best possible results, instead of merely attaining a fixed standard, and assures him that his reward will vary with the merit of his product.—ED ENG. NEWS.]

Heating Feed-Water with Live Steam.

LONDON, Aug. 8, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: As the Englishman alluded to in the article in your issue of July 25, I hope you will permit me to say a few words in relation to heating feed-water with live steam as practised by my firm.

This system of heating feed-water with live steam is economical because no heat which has been drawn from the boiler to heat the feed-water is lost. The steam used in giving up its heat to the feed-water is condensed, and this condensed steam passing into the hot well is returned by the feed pumps through the water space of the heater to the boiler as water of the same temperature as the rest of the feed-water, the amount of heat given up being that due to condensation of the steam to water of the temperature of the feed-water leaving the heater.

The feed-water on leaving the heater and entering the boiler is hot, and very light and greatly expanded. Consequently it rises to the surface rapidly and is sooner converted into steam than would be the case with feed-water at the usual low temperature of 130° Fahr. for compound or 105° Fahr. for triple expansion engines. The water does not stagnate at the bottom of the boiler, as it certainly does where there is no heater, on account of its specific gravity.

The heat passing through the heating surfaces is absorbed by the water in the boiler in considerably less time, causing economy in fuel and greatly benefiting the boiler by assimilation of the temperature of the water entering with that already in the boiler.

To show that there is *no* loss due or possible to the use of a properly designed heater using boiler (live) steam, the fact is that while without a heater say 20 lbs. of steam are being used per I. HP. per hour in a compound engine, it will be found that with a heater at work the amount of steam to be generated in the boiler is greater than before by the amount used in the heater for increasing the temperature of the feed water.

Assuming, for example, that the temperature of the feed water before the heater is fitted is 130° Fahr., and that the heater having been fitted it is raised to 200° Fahr. The additional amount is shown by calculation (A) to be $1\frac{418}{982}$ lbs. per I. HP. per hour, so that with the feed heater at work $21\frac{418}{982}$ lbs. of feed-water per I. HP. per hour returns to the boiler and has to be evaporated against 20 lbs. per I. HP. per hour without the heater:

A: Calculation for amount of steam used in the heater:

Heat required to raise feed to 200° = (200 − 130) × 20 thermal units.

Heat given up by 1 lb. of boiler steam of 103 lbs. absolute pressure = 1182 − 200 = 982 thermal units.

Therefore, the number of lbs. of steam required to raise feed 70° = $\frac{20 \times 70}{982} = 1\frac{418}{982}$.

B: Calculation showing expenditure of heat with and without heater:

1. Without heater:

Total thermal units for 20 lbs. = (1182 − 130) × 20.

Total for 1,600 I. HP. = 1052 × 20 × 1600 = 33,664,000 T. U.

2. With feed heater:

Total thermal units for $21\frac{418}{982}$ lbs. = (1182 − 200) × $21\frac{418}{982}$.

Total for 1,600 I. HP. = 982 × $21\frac{418}{982}$ × 1600 = 33,664,000 T. U.

That is the heat used is absolutely identical with what it was before. The same result will be shown if any other temperatures are taken instead of those given above.

It may be argued that there is a considerable loss of heat by the radiation from the pipes between the heater and the boiler, but this is small and should be avoided by properly protecting the pipes with a suitable non-conducting material, which, if neglected, cannot be considered a loss in any way chargeable to this method of heating the feed-water.

Further advantages accrue to the boiler by freedom from leakages, and decrease in the intense racking strains due to the great difference in temperature between the top and bottom of a boiler without a heater, and also to the increased steadiness with which boilers fitted with heaters have invariably been found to steam.

It is also another very valuable feature that grease and air are eliminated from the feed-water and prevented from passing to the boiler to injure it, which they would in a marked manner if allowed so to do.

It is, I think, a fact that heating surface works more efficiently when evaporating water than when heating it, and also that with these heaters the circulation is greatly improved, which, of course, violently agitates the water, and brings fresh currents constantly against the heated plates, enabling the maximum duty to be secured from the heating surface, and utilizing it to the best advantage.

I shall be most happy to place one of these heaters at the disposal of Mr. GORDON BENNETT, or any other owner of a large steam yacht, so that this question may be thoroughly tested on your side of the Atlantic, if it is thought of sufficient importance, it being understood that the machine will be fitted in accordance with my instructions, and that it will be afterward returned to me in good order or paid for if retained. Respectfully yours,

JNO. KIRKALDY, Assoc. M. Inst., C. E.

The Comparative Merits of Various Systems of Car Lighting.

VIII.

THE PINTSCH COMPRESSED OIL GAS PLANT.

The Pintsch oil gas system of car lighting uses a rich gas made from crude petroleum as the illuminant. The gas is made at central stations and compressed in receivers, from which it is piped into cylindrical steel tanks placed underneath the car. From these it is drawn as needed for use in the car lamps. The principal elements of the system are as follows:

1. A fixed gas plant for generating the gas, of the same general nature as any other gas works, but using crude petroleum instead of coal as the source of the gas. This is done for the double reason that the oil gas is much richer in illuminating properties than coal gas, and does not lose so much of its illuminating power by compression.

2. A compressor which forces the gas after it is generated into storage tanks or receivers at a pressure of 150 lbs. per sq. in. or more.

3. A system of fixed pipes for conveying the compressed gas from the store-holders to various points about the yard convenient for supplying gas to cars; or, in lieu thereof, large tank cars by which the gas can be transported in quantities sufficient for 5 to 10 days' supply to points distant from the gas works.

4. One or more steel tanks beneath each car, for holding a supply of compressed gas, sufficient for 2 to six days' burning.

5. A "regulator" or reducing valve in immediate connection with the car tanks, by which the gas is reduced to the constant and very low pressure (¾ in. to 1 in. of water) which is required for burning gas to advantage, and this under all conditions of varying tank pressure, temperatures, dust and dirt in the air, concussions of service, etc.

6. An ordinary system of gas-piping and burners, modified only in this respect—that to make such a rich gas burn to the best advantage it is necessary to burn it on the regenerative principle, *i. e.*, heat it before burning. We will briefly describe the construction of each of these parts of the plant.

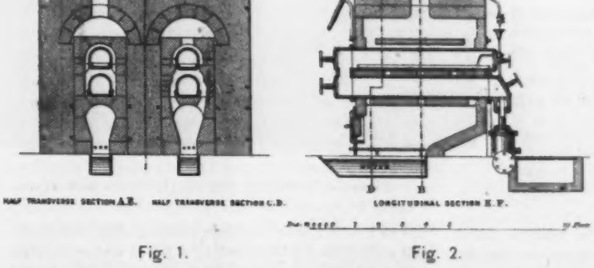


Fig. 1. Fig. 2. Fig. 3.

Retorts Used in Pintsch Gas Works, Glasgow, Scotland; Supplying the Caledonian Ry.

THE GAS MAKING AND STORING PLANT.

A very good description of this, as established at Glasgow, Scotland, to supply the Caledonian Ry., is given in a recent paper read before the Institution of Civil Engineers by GILBERT MACINTYRE HUNTER, Assoc. M. Inst. C. E. We quote from it as follows:

The retorts (Figs. 1, 2 and 3) are D-shaped cast iron tubes, 5 ft. 10 ins. long and 10 ins. wide, placed one above another, the lower one resting its whole length upon a firebrick sole. The flame from the furnace passes round both sides of the lower tube, over the top, and there engages with the upper tube, finally reaching the flue or

combustion chamber. Thus the flame plays directly upon all parts of the tubes, not unduly heating some parts and others partially. The flues are built of ordinary fire-bricks. Both ends of the tubes are fitted with mouth-pieces or covers, admitting of thorough cleaning.

The oil is pumped from barrels into a 15-gall. cistern on the top of the retort bench, which thus maintains a constant head and a steady flow. It enters the upper retort, Fig. 2, in a thin continuous stream from a micrometer cock, through a siphon pipe, and falls upon an iron tray on the bottom of the retort. This prevents the cold stream of oil coming in direct contact with the hot retort and thus reducing its temperature. Here it is partially vaporized, and, passing through the tube, descends to the lower tube, where it encounters a higher temperature, rendering it permanent or "fixed." The object of this is to insure that every portion of the vaporized oil shall be acted upon by the highest temperature, without undue exposure to the heated surface of the retort. As the gas leaves the retort it is largely mixed with tarry and other vapors, which give it the appearance of smoke of a more or less dense nature, in proportion to the quantity of such matters present.

[The author then describes the process of purifying the gas, consisting first in separating the tar by passing the gas in thin streams through water, and then removing sulphur compounds and carbonic acid by passing it through slaked lime and sawdust spread 2 ins. deep in perforated plates.]

At night the main valve is shut, the dampers are closed and the covers over the tar pit are removed, to allow the gas in the pipe to escape; the manhole covers are also removed and the tar and pitchy matter drawn off. The mouthpieces are next taken off, the retorts cleaned out, and the covers replaced; the fires are drawn, and afterward banked for next morning. The fires are kindled with coal and dross; thereafter they are wholly maintained with coke, which gives much better results than coal. After they have been kindled for about an hour and a half the oil is turned on. The proper heat has not been obtained yet; but, owing to the demands on the work, longer time cannot be spared, so that the yield of gas per gallon of oil is comparatively small for the first hour or so. When the retorts are irregularly heated there is a large increase in the quantity of tar; while, if they are overheated, the distillation is attended with a separation of carbon in the form of soot, and if insufficiently there is deposited in the retort a carbonaceous substance resembling coke, in addition to an abundant production of tar. The best temperature is a bright cherry red heat, verging on white; then there is only a small quantity of carbon or soot.

A high illuminating gas can be produced when the yield is small, and conversely, with a high quantitative yield, the light-giving qualities of the gas will be diminished. A fairly good yield, which can be obtained in every-day practice, is 70 to 85 cu. ft. per gall. of 50 to 60 c. p. gas. Mr. J. B. MACARTHUR has shown that a yield of 120 cu. ft. per gall. was only equal to 40 candles, and that whenthe yield reached 158 cu. ft. the candle power was only from 20 to 25.

No. 1 bench was worked continuously for 14 weeks in the winter of 1887-8, during which time 8,294 galls. of oil were distilled, producing an average of 80.76 cu. ft. per gall. During the year 1886 the average yield was 72 cu. ft. of gas per gall. of oil; and in 1887 this was raised to 81.22 cu. ft. Approximately it takes about 5 tons of coke, 4¼ tons of dross and 10 cwt. of coal to make 100,000 cu. ft. of gas, or about 0.22 lbs. of fuel per cu. ft. The cost of making the gas, including oil, fuel, wages, repairs, etc., is 6s. 7.24d. ($1.58) per 1,000 cu. ft.

In another paper read before the Institution of Civil Engineers recently, Mr. ARTHUR AYRES described the gas works on the Pintsch system erected by the Trinity House Corporation at Blackwall, England, for the supply of buoys and beacons. He states that in operating the plant there should be a water pressure of 5 or 6 ins. in the retorts, gradually diminishing to about 1½ ins. in the holder. The gas is made at the rate of about 210 cu. ft. per hour per pair of retorts. The quality of the gas depends more on the temperature at which it is distilled than upon the quality of the oil. The gas shows from 40 to 50 c. p. when burned in a London standard Argand burner with a consumption of 5 cu. ft. per hour at a water pressure of 0.5 in. The quantity of gas produced from one gallon of oil is 70 to 90 cu. ft. The price varies from about 5s. 6d. to 16s. ($1.32 to $3.84) per 1,000 cu. ft. Where the demand is great, the cost of production is correspondingly low.

From Mr. AYRES' paper we condense the following table, giving particulars of the Pintsch Gas Works on several British railways:

Name of Company.	Cost of works.	No. of works.	No. of retorts.	Yield p. retort p. hour, cu. ft.	Cu. ft. gas per gall. of oil.	Net cost p. 1,000 cu. ft. Annual output, thousands of cu. ft.	Exclusive of interest and repairs.	Adding interest and depreciation at 10 %	No. of cars equipped.	Gas consumed per burner per hour cu. ft.
Caledonian	$19,420	1	8	480 to 600	81.17	1,892	$1.58	$2.61	603	0.74
Metropolitan	38,800	2	16	150 to 175	77.00	8,500	1.44	1.89	310	1.035
Midland	20,127	1	6	——	74.16	3,948	1.68	2.19	182	0.75
Glasgow & Southwestern	16,975	—	5	——	76.25	1,316	1.57	1.69	440	——
London & Southwestern	30,264	2	20	507	81.00	2,697	1.37	2.83	890	0.70
Great Eastern	33,465	1	12	134.5	72.00	3,460	1.48	2.44	611	0.75

NOTE.—The gas is measured for the purposes of the above table as it passes into the holder, before compression. The quantity of gas available for lighting is probably 10% less.

The loss of candle-power of oil gas made from crude petroleum when compressed was found to be as follows in experiments made some years ago by JULIUS PINTSCH:

5 atmospheres	2.4%
10 "	7.4%
15 "	16.3%
20 "	21.5%

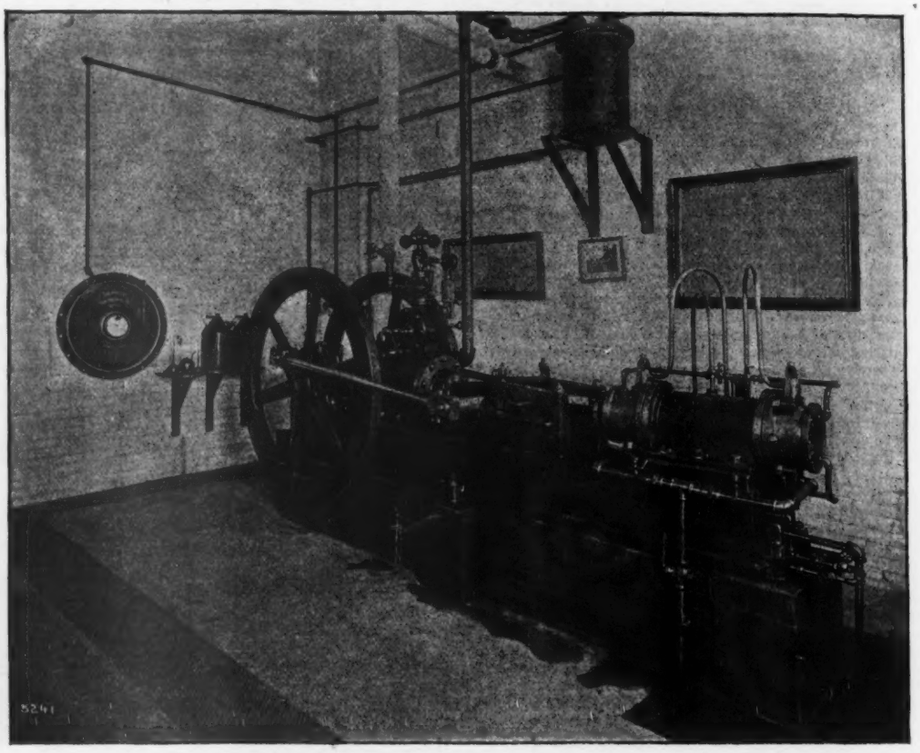
In compressing the gas for use on cars at the Glasgow works, as described by Mr. HUNTER, a compound compressor is used and the gas is compressed to about 60 lbs. in the first cylinder and 150 to 180 lbs. in the second cylinder. The compressing cylinders are kept cool by a jet of water running around them. In going from the gasholder to the compressing pumps the gas passes through a freezing cylinder which converts to ice any moisture which the gas may have taken up in passing through the washer and holder. It also economizes the power necessary for compression and reduces the heat of the pump cylinders.

The compressed gas is stored in steel tanks of any convenient size. Pipes lead from the bottom of each to a receiving drum to draw off the liquefied hydrocarbon, which collects in the bottom at the rate of about 1 gall. for each 1,000 cu. ft. of gas. Mr. HUNTER says:

On an average the gas loses about 5 c. p. by compression and deposit of the hydro-carbon. The hydro-carbon gives off an inflammable vapor at a temperature of less than 45° Fahr. It is, accordingly, rather a dangerous substance to work with, and is generally drawn off from the drum in to smaller ones for transmission to manufacturing chemists on a dull, moist day.

The process, as above described, is substantially that used in this country in the manufacture of Pintsch gas. The compressors used however, are not compounded. The accompanying engraving is reproduced from a photograph of the compressor at the Pintsch gas works in Boston.

The following are official figures from a gas-works on one of the leading railways using the Pintsch system in this country. Between July 1, 1890, and Jan. 31, 1891, this works made 1,483,782 cu. ft. of gas at an average total cost per 1,000 ft. when placed in the car tanks of $4 206.



Gas Compressing Engine at Boston Gas Works of the Safety Car Heating & Lighting Co.

This was divided as follows:

Labor on works	$.94
Labor, car filling	.452
Supplies and repairs	.629
Coal	.418
Oil	1.207
Net total	$3.646
Interest on investment	.56
	$4.206

The total items of expense for this six months' run were as follows:

146.07 tons egg coal	$436.76	
91.00 tons pea coal	183.02	
		$619.78
32,762 galls. oil		$1,791.39
Labor at works		1,394.88
Labor, car filling		670.62
Repairs, etc		965.49
Incidentals		967.03
Net cost		$5,409.19
Interest on total cost of works ($24,285), $118.31 per month		831.67
Total cost		$6,240.86

Total cu. ft. furnished cars	1,483,782
Average cost per 1,000 cu. ft.	$4.206
Total number of cars supplied (all classes)	11,866
Average cu. ft. per car	126
Average cost per car	53 cts.

Cost per day (24 hours) Based on Average of 9,489 cu. ft. furnished cars for month of January, 1891.

Labor in gas-works	$5.87
Labor of car fillers	4.645
Coal, 2,045 lbs. egg, Coal, 1,590 lbs. pea	4.12
Crude oil, 224 galls.	11.21
Supplies and incidentals	3.885
Repairs	6.185
Net cost	$36.915
Interest on cost of plant	3.8325
Total cost	40.750
Net cost per 1,000 cu. ft.	$3.89
Total cost per 1,000 cu. ft	$4.295
Lbs. coal per 1,000 cu. ft, 383; cost	$0.43⅛
Galls. oil, per 1,000 cu. ft., 23 6-10; cost	$1.18

It thus appears that the average production is about 45 cu. ft. of gas per gall. of oil, a much smaller result than is obtained abroad. This is partially explained by the fact that the gas in the English reports is measured before compression, while the American figures are for the gas delivered in the car tanks. Mr. AYRES estimates a loss of about 10% by the condensation which takes place on compression, and by leakage.

In addition to this, it is stated that the crude petroleum used in American practice is a thinner and lighter oil than that distilled from shale, which is commonly used in England, or the Russian petroleum used in Germany. The interest on the cost of the works in the above case is excessive from the fact that the building is designed for 8 benches of retorts, whereas only 4 benches are in place, and only 3 of them are working. But even these considerations do not wholly account for the very small yield of gas per gallon of oil, and it is believed that the oil is fed too rapidly to the retorts, so that a considerable percentage is vaporized and passes over without being converted to a fixed gas, and is therefore condensed and carried off with the tar. In English practice the quantity of tar per 1,000 cu. ft. is 4 or 5 gallons, increasing largely when the retorts are underheated, or when the oil is fed too fast. When the tar contains oil it is thin and flows freely, and a drop on a piece of white paper prodnces a transparent, greasy border around the tar.

A Pintsch gas-works in the same city as the plant for which the above figures are given, but operated by another railway company, showed the following record in three months of the current year:

COST OF COMPRESSED GAS AT GAS HOUSE, INCLUDING THE COST OF RENEWALS, REPAIRS, CAR FILLING, ETC.

Month, 1891.	Quantity.	Total cost.	Cost per 1,000 ft.
February	352,000 cu. ft.	$643.99	$1.83
March	342,000 "	615.33	1.80
April	318,600 "	646.04	2.03
Average cost of oil per gallon			$0.041
Average cost of coal per ton			3.55

This does not include interest on the cost of plant. Taking this as 6% on $15,000, we have an additional item of expense of $75 per month. This would make the average total cost of gas per 1,000 ft., including interest on plant, $2.10 for three months.

This, as will be seen, is just half the cost at the works first described, and compares very well with the records of the plants on English railways.

The above two plants are operated by railway companies. The Safety Car Heating & Lighting Co. also operates several gas-works located at different railway centers. One of the largest of these is at Mott Haven, supplying gas to cars of the New York Central & Hudson River, New York, New Haven & Hartford, Boston & Albany, New York & New England, and Wagner Palace Car Co. The following table shows the details of cost of gas at these works during the first half of 1891:

Month.	Yield of gas per gal. oil.	Coal used per 1,000 cu. ft.	Total gas put in cars.	Cost per 1,000 cu. ft. in cars, ex. clu. of int., but inclu. repairs.	Cost per 1,000 cu. ft. in cars, including 10% int. and depre'n.
	Cu. ft.	Lbs.	Cu. ft.	$	$
Jan.	65.4	247	797,713	1.98	2.23
Feb.	63	205	688,823	2.59	2.88
Mar.	60.4	212	718,538	2.11	2.38
Apr.	64.1	176	563,959	2.71	3.04
May	61.3	187	607,594	2.39	2.71
June	61.3	185	633,808	2.35	2.66

Thus the average cost per 1,000 cu. ft. in cars, including interest, repairs, depreciation and charges of every nature, for the above six months, is $2.65. At this rate, gas burned in the 4-flame Pintsch lamps, consuming 2¼ cu. ft. per hour, would cost $0.0066 per lamp per hour; or in a car equipped with five lamps the cost would be 3.3 cts. per hour. This, of course, is exclusive of interest on, or repairs and deciation of. car equipment, or attendance upon the plant on the cars. It should be said that the above figures include not only the cost of filling cars in the Mott Haven yards, but also the cost of transporting gas in tank cars to Grand Central Station and filling cars there, which we are informed increases the cost on the total amount of gas delivered from the Mott Haven works at least 10 per cent.

The Safety Car Heating & Lighting Co. also state that, other things being equal, railway companies can operate works owned by them from 10% to 15% cheaper than a private corporation like the Pintsch Co., owing to cheaper transportation and the advantages due to buying coal oil and other supplies in large quantities and at better prices.

The average yield of gas per gallon of oil is seen to be much higher than at the first works, for which figures were given above; but it is considerably below English records, for reasons already stated.

We are also favored with some data of the Erie gas works at Jersey City, which supply 200 cars and 6 ferry-boats. The works are located in a brick building with 12-in. walls, 28 ft. 4 ins. × 38 ft. 6 ins., on a tract 30 × 115 ft. The cost of the building, with the tank for the gas holder, exclusive of contractor's profit, was $4,100. The plant will make 24,000 cu. ft. of oil gas per day, or enough for 500 cars. The total cost of machinery and fittings in the works was $11,100, f. o. b. New York City. Average daily consumption of gas per car in all kinds of service is taken as 50 cu. ft., the lamps being supposed to burn 4 hours at the rate of 12½ cu. ft. per hour. Coal is burned at the rate of about 100 lbs. per 1,000 cu. ft.

Irrigation and Irrigation Systems in San Bernardino County, Cal.

BY F. C. FINKLE, C. E.

(Continued from Page 149.)

The next phase of irrigation in this county is the irrigation district system. The mode of organizing and operating irrigating districts was described in the first part of this series, page 2 of the present volume. At the beginning of 1891 there were in San Bernardino Co. five irrigation districts, as follows:

District.	Area in acres.
East Riverside	3,000
Grapeland	10,787
Rialto	7,200
Citrus Belt	11,800
Alessandro	25,340
Total	58,127

EAST RIVERSIDE IRRIGATION DISTRICT.

This district is situated on a high mesa, directly east of the Riverside Colony, and overlooking the entire San Bernardino Valley. It has a greater elevation than any of the land in the vicinity which is under water and is in small holdings, having been taken up from the government. These causes have kept private capital from investing in irrigation works, but under the Wright Irrigation District act a district has been organized and bonds issued. The writer has been engaged as Chief Engineer and in accordance with his recommendations, 60 acres of artesian land, 7½ miles from the district, have been bought. This land is 50 ft. above the highest point in the district. It is proposed to develop, by sinking wells, 12 cu. ft. of water per second, and convey this from the receiving reservoir through a 30-in. steel conduit to a distributing reservoir located on the highest point in the district. From this reservoir iron pipes will convey the water to the highest point on each 40-acre tract, where it will be delivered under pressure ranging from 120 lbs. down. The estimated cost of the work was $250,000.

The 30-in. conduit from the wells to the district will cross the valley of the Santa Ana River, and at some points will resist a pressure of 150 lbs. per sq. in. To answer these conditions I devised a conduit to be riveted from mild steel plate and coated with asphaltum as a protection against rust. This kind of pipe has been much used on the Pacific coast, both in irrigation and hydraulic mining, and where it has been properly manufactured and laid it has been found to answer the same purpose as cast-iron or lap-welded wrought-iron pipe. The latter, on account of freighting from the East, is so expensive that its use is out of the question on the Pacific Coast, but a substitute has been found which, while it costs only half as much, is equally as good in every particular. Those who have had no experience suppose that sheet iron or steel pipe is not durable, but we have proved on this coast that such pipe, when well coated with asphaltum, is very durable. We have such pipe, which has remained for 20 years in the ground in constant use, and still is as sound as when first laid. The following is the text of the specifications for the conduit of the East Riverside Irrigation District, with the omission of familiar and merely local details:

The district will receive bids for about 39,000 ft. of 30-in. steel conduit to carry the water for irrigating the district, from the receiving reservoir to be located on the artesian lands of the district, across the valley to the distributing reservoir to be located on Sec. 33, T. 2 S., R. 4 W., B. B. M., in the district; said bids to be per lineal foot separately for each weight of steel. This conduit shall be made of mild steel plate having the grain of the steel lying around the circumference of the pipe, and having parallel courses both inside and outside.

Size.—The interior diameter shall be 30 ins., and the length of each course shall be from 36 to 48 ins.; there shall be either 6 or 8 courses, one-half large and one-half small to each separate length, and a large course must be at one end, and a small course at the other end of each length.

Material.—The pipe must be made of mild steel plate having a minimum tensile strength of 60,000 lbs. per sq. in., and an elastic limit of at least 25,000 lbs. per sq. in. Each plate must be perfectly flat, smooth and even, and free from warping, buckling, flaws, splits, rust, scale and other defects. The steel must be very tough and pliable, allowing cold scarfing to a fine edge at the laps without cracking or splitting, and must not crack between the rivet holes and the edge of the plate while being rolled All plates which exhibit a hard brittle character, and that do not in every respect meet the above requirements, must be rejected and not used in the manufacture of pipe. The engineer of the district will inspect and examine all pipe before it is dipped, both as regards material and workmanship, to see that it is up to the requirements of these specifications, and said engineer shall have power to reject any pipe found defective either in point of material or workmanship. During process of manufacture of the pipe, the contractor must keep all plates and rivets received by him in a store-room which does not admit rain, fog or moisture, and the pipe after it is manufactured must be cared for in the same way until it is dipped.

Rivets.—All rivets used must be of the best quality and free from rust. Seam rivets must be used for all riveting where only two thicknesses come together, and lap rivets where three thicknesses are riveted.

SPECIFICATIONS FOR MANUFACTURING RIVETS.

Position of rivets.		Size of body, inches.	Size of head, inches.
Number 12 plate	Seam	5-16×11-16	5-8×5-32
	Lap	5-16×13-16	5-8×5-32
Number 10 plate	Seam	11-32×11-16	11-16×3-16
	Lap	11-32×27-32	11-16×3-16
Number 8 plate	Seam	3-8×11-16	11-16×3-16
	Lap	3-8×7-8	11-16×3-16

Riveting.—Before the plates are riveted into courses they must be rolled into the proper shape by being passed through a suitable rolling machine. All straight seams must be double riveted and all round seams must be single riveted; all rivet holes must be perfectly fair and made with a multiple punching machine, or a machine of equal precision; no reaming or gouging of rivet holes will be permitted, and all plates so spoiled must be replaced by others. All riveting must be done by hand and in a thoroughly workmanlike manner; machine riveting will not be accepted. Wherever there are double rows of rivets they must have the rivets occurring zig-zag in the rows taken together, and not have any rivet in one row occurring opposite to any rivet in the other. Special care must be used in riveting at the laps to drive the rivets well and hammer the outside sheet down to make the pipe tight at the laps.

POSITION OF RIVETS.

Gage of steel.	Distance apart in rows on str'ght seams, inches.	Distance apart of two rows in str'ght seams, inches.	Distance apart on round seams, inches.
12	1.33	⅞	⅞
10	1.40	⅞	1.00
8	1.40	⅞	1.00

Weights of Steel.—The pipe will be manufactured of three gages of steel, Nos. 8, 10 and 12. The lengths

will be as follows: No. 8, 8,900 ft.; No. 10, 19,075 ft.; No. 12, 11,025 ft.; total, 39,000 ft.

Chipping and Calking.—All the pipe manufactured of No. 8 and 10 steel shall be chipped and calked both in straight and circular seams and in all joints, especial care being taken with the edges of the sheets that they are well chipped and calked near the laps. Of the pipe manufactured of No. 12 steel 8,025 ft. shall be chipped and calked the same as Nos. 8 and 10, and the balance, or 3,000 ft. of No. 12 steel, shall be plain pipe simply dipped as hereinafter provided.

Asphaltum Coating.—All lengths of pipes that have been riveted, chipped and calked as above specified shall be inspected by the engineer of the district, and after they have been so inspected shall be dipped in an asphaltum bath as follows: Blocks of refined asphaltum of the best quality shall be melted in a vat and fluxed with sufficient crude oil to make it of the proper consistency when melted and hot. This mixture shall be made as hot as it can without burning, and the pipe immersed therein and allowed to remain for a sufficient time to receive a heavy coating. The coating must be such that it will not soften in the heat of the sun, and must not be so brittle that it will peel off under ordinary low temperatures. More crude oil will not be permitted to be used in the composition than to overcome excessive brittleness, and if, when the dip is tested, it is found to remain soft after cooling to 100° F., it must be hardened by adding more asphaltum.

Testing Pipes.—After the pipes have been dipped, and before they are shipped, each length must be tested in a hydraulic testing machine to the pressures following:

No. 12 steel, plain, 100 lbs. per sq. in.; No. 12 steel, chipped and calked, 150 lbs. per sq. in.; No. 10 steel, 250 lbs. per sq. in.; No. 8 steel, 350 lbs. per sq. in. While under this pressure the pipe must be free from leakage through all seams and joints.

Repairing Pipes.—Whenever the asphaltum coating is chipped off or bruised in transportation or from other causes, the pipe must be retouched with a hot mixture of the same kind with which it was originally coated. This retouching must be done before the pipe is covered when it is being laid.

Air Valves.—Air valves, 14 in number, must be attached to the pipe on all high places where indicated on the profile of the line. All air valves used must be 2-in. Chabot air valves, and they must be connected on top of the pipe with a tight service clamp. The stems must be 2-in. standard lap-welded screw pipe and of the lengths required to reach the ground as shown on the profile of the line. A service cock must be placed on the stem below each air valve to shut off the water in case the valve requires repairing. All air valves must be boxed in with a box made of a piece of 12-in. pipe of sufficient length to reach to the surface of the ground. A perforated and hinged lid must be placed on every box and have latch and padlock for locking it. Where air valves occur in streets or public highways a cast-iron lid sufficiently heavy to resist the traffic must be used to cover the box.

Curves.—Curves for all angles in the line must be made according to detail drawings thereof made by the engineer and submitted with these specifications. These curves must be of the gages of steel of the pipe they are intended to connect, as also is shown on said detail drawings.

Air Stand-Pipe.—An air stand-pipe must be erected at the point indicated on the profile of the line made by the engineer and submitted herewith. This stand-pipe will be 6 ins. in diameter and of the height indicated on said profile. A framework in the form of a derrick must be erected to support the stand-pipe, according to detail drawing thereof submitted with these specifications.

Blow-Offs.—Eight-inch blow-offs must be attached to the line at the points where they are indicated on the profile of the line. The valves for closing the blow-offs must be standard 8 in. gate valves attached to the tees in the line with lead joints.

Gates.—The contractor must set two gates and furnish the same of some standard class of gates to be approved by the engineer. One of these gates will be a 30-in., which will be set at the discharging end of the line. A foundation of masonry 4 ft. square and 3 ft. deep must be constructed on which the 30-in. gate will be placed. The masonry must be of good hard rock not of dimensions less than 1 cu. ft. for each rock and laid in mortar of sand four parts and English Portland cement one part by measure. The other gate will be a 12-in. to be placed on a tee to be inserted in the line just below the 30 in. gate. The foundation for the 12 in. gate will be of masonry same as above specified only 2 ft. square and 2 ft. deep. Both gates must be set with lead joints and gaskets such as required for making joints on cast iron pipe.

The following paragraph from the general stipulations may be added:

The contractor furnishing and laying the pipe shall furnish all vertical curves to conform to the grades shown on the profile at the same rate per foot as straight pipe, and shall anchor the pipe either with masonry or piles at all points where it makes sudden vertical bends, to insure absolute stability under full working pressure. There shall be furnished and inserted in the line 5 expansion and contraction joints for the points marked in the profile by the contractor having the furnishing and laying of the pipe. Across the Santa Ana River the district will provide the contractor with a trestle and box in which he can lay the pipe.

The specifications for the artesian wells from which the water supply is to be derived are as follows, with some omissions:

Size of Wells.—All wells must be started with casing 9½ ins. in diameter, or over, which casing shall be sunk to as great a depth as practicable before reducing.

Depth of Wells.—All wells shall be sunk to a depth of 500 ft. if obstacles are not encountered which make this impossible. The contractor shall use his utmost endeavors to attain a depth of 500 ft. with each well sunk by him but when it is impossible to do so, the engineer in charge may receive a well which has not attained a depth of 500 ft. after requiring the contractor to perforate the pipe to admit such streams as are passed in boring. But in no case shall the engineer in charge accept a well which is not at least 200 ft. in depth.

Material of Casing.—All casing used shall be of the best red iron, sometimes called steel-well pipe. All pipes shall be in sections of 2 ft. Casing having a diameter of 7 ins. or over shall be of No. 12 Birmingham wire gage iron and casing less than 7 ins. in diameter shall be of No. 14 iron.

Workmanship of Casing.—The sections of pipe shall be riveted from plate punched with a multiple punching machine or machine of equal precision, and the riveting to be done by hand and in a thoroughly workmanlike manner. All rivets used shall be of the best quality in the market as regards tensile strength and the proper grade of hardness. All pipe must be square on the ends and made so that the inside pipe fits perfectly into the outside.

Starter.—The starters used in starting each string of casings shall be of standard lap-welded wrought-iron pipe not less than 15 ft. in length. The starter shall have a solid steel shoe on the down end, which shall be made of first-class well tempered steel.

Reducing Wells.—When in the opinion of the engineer in charge the string of pipe with which the well was first started cannot be sunk deeper, said engineer shall advise the contractor what size of casing shall be used for reducing the well. The size of casing used in reducing a well shall be of as great a diameter as will with safety enter the string of casing next preceding it. The contractor shall in no case proceed to reduce the size of a well without first consulting the engineer in charge and obtaining his consent. Reductions in a well by the used of riveted casing may continue until the last string sunk has a diameter of 6 ins. If any further reduction shall be deemed advisable by the engineer in charge, such further reduction shall be made with 4-in. lap-welded screw pipe.

Deep Wells.—If the contractor can and will, after having reached a depth of 500 ft., still continue deeper he may do so with the consent of the engineer in charge, and the sum paid per foot for such greater depth shall be proportionately increased over the price paid per foot for the preceding 100 ft. in the same ratio as the preceding 100 ft. were increased in price over the next preceding.

Accidents.—If an unavoidable accident shall put any well in such a condition that it cannot be reduced and continued deeper, and such well has already reached a depth greater than 200 ft., the engineer in charge shall have authority to have such well properly perforated and accept the same; but if it can be clearly shown that any well has been put in such condition by carelessness and negligence or incompetence of the contractor or his employees the contractor must abandon the same at his own expense.

Number of Wells.—The number of wells to be sunk under these specifications shall be 10, and any well accepted and paid for by the district shall count one.

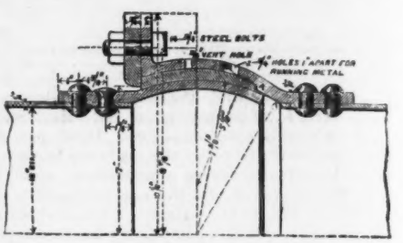
Record.—The contractor shall be required to keep in a book, suitable for the purpose, a correct record of the strata through which each well is sunk; said record shall be at all times open to the inspection of the engineer in charge, and upon completing his contract the contractor shall turn such book over to said engineer.

(To be continued.)

Flexible Joints for Water Pipe, Liverpool, England.

The accompanying cut represents a form of flexible joint designed by Mr. DEACON, Corporation Engineer of Liverpool, England, for use on the temporary pipe line across the bed of the Mersey River, as described in our issue of July 4. The construction of the joint is clearly shown. The work on the tunnel through which the mains are to be laid eventually to bring the new water supply from Vyrnwy reservoir has been considerably delayed, and the temporary pipe line, consisting of 50 lengths of 12-in. steel pipe, or a total length of 800 ft., has therefore been constructed. Mr. DEACON also designed some special valves which were attached to the under side of the pipe, the idea being that the pressure of the water in the pipes would open the valves and scour out a bed, the valves afterward closing automatically. The following, from *Industries*, briefly describes the system of laying the pipe, as more fully set forth in the issue referred to:

The pipe line of 800 ft. was laid zigzag in a trench, a block of wood being under each joint, and riding on the "ways"; along each side of the pipes was a wire rope secured to the extreme end of the pipes, and passing over to the Cheshire side of the river, where they were attached to a steam winch. Eight boats were moored at intervals across the river to guide the pipes as they were being drawn across; a number of horses were also attached, and, with



Flexible Joint for Water Pipe.

the united forces of the steam winch and the horses, the pipes were successfully pulled across the river in 27½ mins.

It has been stated in some of the English papers that there was a very great loss of water by leakage on this pipe line, but Mr. DEACON has declared in a published letter that these statements have no foundation in fact.

The Vyrnwy aqueduct (including the temporary steel pipes under the Mersey, and their flexible joints) is remarkably water-tight, and the temporary pipes are answering admirably the purpose for which they were intended. Any excess of supply from Lake Vyrnwy over and above that which reaches Liverpool is to be found in the intermediate reservoirs or at prescribed points of overflow. The contracted pipe beneath the Mersey conveys to Liverpool all the water it is calculated to convey under the existing conditions of head, all indeed that is wanted; if more comes toward it the excess naturally overflows at one of the five reservoirs on the aqueduct.

Metal Tie-Plates for Railway Track.

In this country, and in other countries where the flange or tee rail is used, considerable trouble has been experienced from the cutting of the ties by the flange of the rail, this being especially the case where ties of soft wood are used. This cutting of the ties decreases the hold of the spikes upon the rail flange, thus endangering the safety of trains, and it also adds to the cost of track maintenance and renewals. In some cases ties which are physically sound have to be taken out on account of the excessive amount of flange cutting. This trouble has led to the introduction, both here and abroad, of metal tie-plates to increase the safety and durability of the track by preventing the flange cutting and adding to the efficiency of the fastenings, and their use, especially with soft wood ties, has been found to effect a decided economy in the track work. In Europe the general practice is to use a heavy form of plate, while a lighter plate is more generally used in this country, although heavier plates, with improved fastenings have been designed. In ENGINEERING NEWS, March 16, 1889, was published an article on the advantages of tie plates, referring to the Servis plate, then being quite extensively used, and in our issue of April 4, 1891, was illustrated the improved form of the Servis tie plate, as adopted by the Boston & Albany R. R. for use with its new 95 lb. rails on chestnut ties. Two of the American designs for heavier plates, and with bolt or screw fastenings instead of the ordinary spikes, were described and illustrated in ENGINEERING NEWS, May 11 and Nov. 23, 1889, and the form of steel tie-plate adopted on the Belgian State Railways, in our issue of July 18, 1891. The following notes on the use of tie plates are taken from a paper on "Steel Rails," by Mr. C. P. SANDBERG, M. I. M. E., which was read in July, 1890, before the Institution of Mechanical Engineers, England. An abstract of this paper, dealing only with the part referring directly to the rails, was given in our issue of Aug. 23, 1890, and in our issue of

Nov. 9, 1889, were given the plans of Mr. SANDBERG's steel tie plate or "base-plate."

Flange Rails without Tie Plates.—As English railways rank first in respect to safety, economy of maintenance, and speed, they were naturally regarded at the Paris congress as the best for high speed and heavy traffic. Even the double-headed rails and chairs laid on half the railways in France, although the rails are somewhat old-fashioned, were considered superior to the flange rail. In England some flange rails have also been used in old days on branch lines with light traffic, but most of them have been replaced by rails of the double or bull head form usual in this country. An interesting paper has this year (1890) been written in *L'Industrie Moderne* by Mr. FLAMACHE, engineer of the Belgian State Railways, balancing the pros and cons of the two plans, but he forgets that there is no choice, or at least very seldom, inasmuch as a change of system could hardly be carried out. For a heavily worked railway to exchange its flange rail for a double or bull-headed rail with chairs is almost an impossibility; therefore it is not a question of choice, as in constructing a new line. Hence even those who in Paris recommended the English plan as the best, preferred themselves to strengthen their own lines by the adoption of heavier flange rails to correspond with their increased traffic. Every railway will have to keep to its own form of rail, whatever may be the opinion about the best.

Goliath Flange Rail with Steel Tie Plate and Steel Key.—Then comes the question whether, by adopting heavier flange rails with steel base plates of equal surface to the chair, a road cannot be made as good and strong as on the English plan. As to the cost, a small saving may be counted upon for the Goliath flange rail, with large steel base plates weighing 13 lbs. each, which latter cost only two-thirds of the chairs. But, be that as it may, the main question whether as good and strong a road can be obtained will be answered by the Goliath rail already adopted on the continent. There is also hope of a fair comparison in England from a trial of the Goliath flange rail with steel base plates and steel keys, all made at the Barrow Steel Works; this trial is now being made on the Furness Ry., thanks to the managing director, Sir JAMES RAMSDEN, and the engineer, MR. STILEMAN. Hitherto the flange rail laid in England has had but a poor chance in competing with the double or bull-head rail, because nowhere has it been of equal weight, nor has it had a steel base plate. America, where flange rails only are used, shows that plan of road to great advantage; for even admitting that their flange rails are weak, although they have lately increased their weight from 60 lbs. up to 80 lbs. per yard, [to 80, 85, 90 and 95 lbs.—ED. ENG. NEWS], their speed is quite as high as on the continent of Europe, and their freight tariff is only half that of the English railways, and still they pay a dividend. There is ample room, however, for increasing the weight of their flange rails still further, even up to 100 lbs. per yard, before they reach the cost of the English lines, notwithstanding that the centers of the sleepers (ties) are only 2 ft. apart on the American roads, instead of 2½ ft. as on the English. While the author has no idea of introducing the flange rail on English lines, any trial of that plan in this country, for the sake of comparison, would greatly benefit both the foreign railways and the English steel rail trade generally, if it could be proved that by means of the Goliath rail with base plate, as good and strong a road could be obtained as by the present English plan; for heavier rails would then necessarily be adopted abroad wherever the traffic has grown beyond the capacity of the lines originally constructed with light flange rails, and would thus benefit all such railways and the rail trade.

Base of Flange Rail and Fixing to Tie.—In respect lastly to the most important part, namely, the base of the flange rail and the mode of fixing it to the sleeper, there is here a very great difference from the chair; for while the rail joint is certainly a weak part of the road, the base is the weakest in regard to both safety of gage and economy of sleepers. Valuable experiments on the stability of the rail, both vertically and horizontally have been made by Mr. BRIERE, engineer of the Orleans Ry. Several voices besides the author's was heard at the Paris congress in favor of base plates. Mr. BEMELMANS, engineer of the Belgian State Railways, spoke strongly on the subject; and in reporting upon the pressure exerted on the rail by the rolling stock, he remarks that, with the heavy engines now used, each axle may carry 15 tons dead load, or 7½ tons per wheel, while this load in running might, from various causes, be momentarily even double or 15 tons per wheel. On a curve he considers that besides the vertical pressure of 15 tons, the horizontal pressure on the outer rail may be half as much; and he calculates that the pressure of the outer rail on the sleeper is as follows: For the flange rail of the section used on the Northern Ry. of France, weighing 86 lbs. per yd. and laid direct on the sleepers without base plate, 6.3 tons per sq. in.; for the Goliath rail of the section used on the Belgian State Railways, weighing 105 lbs. per yd., and with base plate, 1.0 ton per sq. in.; for the bull-head rail used on the London & Northwestern Ry., weighing 90 lbs. per yd., and with chair, 0.3 ton per sq. in. In a straight line he calculates the pressure on the sleeper in the same three cases to be: on the Northern Ry. of France, 1.3 ton per sq. in.; on the Belgian State Railways, 0.4 ton; and on the London & Northwestern Ry., 0.16 ton per sq. in. These figures explain why with a large traffic the sleepers, even of oak, where the rail is without base plates, are literally cut under the rail base, and are early rejected, not because they are decayed, but because the pressure is too great and the fastenings of wood screws or spikes are not strong enough to hold the rails to the gage. On the Paris, Lyons & Mediterranean Ry., Mr. MICHEL, engineer of the permanent way, has taken to base plates, the need of which is also proved in his report at the congress on the lines carrying express trains. With sleepers of softer wood than oak, such as fir or cedar, how much more valuable will the base-plates be. No lengthened argument is wanted to show the necessity of the base-plate for flange rails; all that is needed is to use common sense, remembering that a flange rail with base 5 ins. wide, the widest that can be conveniently rolled, has not half the bearing surface of a chair on the sleeper. With comparatively light traffic the steel rail will last a long time, say 30 years; and in such cases it may fairly be asked why it should be made heavier so as to last 50 years. But the fir sleeper does not last more than 7 years, and what is worse it is attended with great trouble in maintaining the gage. Here, therefore, the base-plate will be beneficial, only it must be large enough to give nearly as much bearing surface as the chair, and thick enough not to bend, and must be fixed to the sleepers beforehand, like the chair; and the rails must be fixed to the base-plates by steel keys, as on metal sleepers, so as to obviate the necessity for extreme accuracy in the position of the holes in the base-plate for the spikes and for the width of the rail base. Several railways are progressing in this direction with advantage; and in view of the trials now being made on the Furness and other railways it may be hoped that even with the flange rails and steel base-plates, if something like the same cost be spent upon the plan, an approach will soon be made to the good English roads.

Street Cleaning in Paris.

One of the officers of the Bureau des Travaux de la Voie Publique of Paris has contributed to the New York *Herald* an account of the methods of street cleaning employed in that city, of which we make the following abstract, although repeating some matter already published in this journal, as affording an interesting comparison with the methods employed in the leading cities of America. While the figures may not be absolutely correct, the explanation of the work is especially interesting in view of the wide-spread interest in the subject.

In Paris, the entire city is thoroughly washed down with water every five or six days during dry weather and more often during a wet season. This washing—which is no mere superficial work, but a thorough scrubbing and cleansing of the streets, as carefully done as the washing of the interior of a house would be—takes place early in the morning, beginning between 3 and 5 o'clock, according to the season of the year.

The process is generally as follows: In each block there are several water mains, so that wherever needed along the street, water can be played freely from a large hose which is run along on rollers. The roadman in charge of the hose comes first in the party. The nozzle is coarse and the power of the water great enough to dislodge from the pavement any dirt that may have become incrusted.

What the hose fails to accomplish is speedily completed by those who come next with the hardest bristle brushes. The cleaning gang follow the hose in two diverging lines like an arrow-head, and pass the mud along until it reaches the gutter. Then they form in line along the gutter. In each block there is a street inlet, beside which one of the workmen stands and shovels down the mud as it is passed along to him.

Where the pavements are of wood and asphalt, as is the case in nearly all the leading boulevards and streets, a stiff plate of rubber held in a wood frame and forming a kind of flexible hoe is largely used in place of the broom and is found to be highly effective. The machine sweepers are also largely used, but not on level pavements. They generally clean about 6,000 sq. yds. an hour, while a laborer is expected to do about one-tenth as much.

The sweeping is carried out by the city each morning and during the day. Formerly the morning sweeping was done by the householders, but by a law of 1873 the inhabitants gladly relieved themselves of the task by paying a lump sum to the city, which has since taken charge of it.

The total surface which is swept twice a day is approximately 18,600,000 sq. yds. (?) and the annual cost of the work is 6 cts. per sq. yd.

The sweepers are enrolled in brigades, of which there are 149, each composed of a chief, sub-chief and 25 laborers, both men and women, the majority of whom work in the morning only.

For more than the half day are retained only those having the title of roadmen, whose duty it is to see that all the work is properly carried out, such as supplementary sweeping and flushing of the gutters. This is done by unlocking the small cocks, of which there is one on each side of every block, and thus thoroughly cleansing the gutters with pure water. This flushing is manipulated by the roadman so as to cause the water to flow first in one direction and then in the other by making a small dam of sackcloth in the gutter. The flushing continues throughout the day, carrying away the dust in dry weather and the mud when it rains. The water that is used comes from the Seine River.

The regular laborers begin work at 4 A. M. throughout the year and their day closes at 4 P. M. Those who work only on half-day time stop at 11 A. M. The organized service consists of about 3,200 persons, the majority of whom are employed in the center of the city, where the traffic is greatest and the markets are located.

The number of auxiliary laborers varies greatly, depending upon the condition of the weather. The sweepers are paid as follows: Able-bodied men, 6½, 6⅞ and 7⅜ cts. an hour; old men, women and children, 5, 5½ and 6 cts. an hour. The monthly salary of the roadmen is $25 and $24 for chiefs and $21 for subordinates.

Watering commences, except under exceptional circumstances, on March 15 on the macadam, and April 15 on the paved streets, and terminates Sept. 30 on the paved and Oct. 15 on the macadam streets.

Originally all the public roads were watered with carts, costing .0002 ct. per sq. yd. for macadam and .0001 ct. for paved streets. For several years past, however, the principal thoroughfares have been watered with the hose.

This hose is composed of a number of iron tubes, joined together with strong waterproof canvas joints and mounted on wheels for greater ease in moving. The hose is screwed to a cock which lies beneath the level of the sidewalk. By this system the total cost of watering, including labor, apparatus and water, amounts to .000109 ct. per sq. yd. The surface now tended in this manner embraces about 3,770,000 sq. yds.

The watering cart on paved surfaces can cover about 24,000 sq. yds. daily, whereas on macadam roads the average duty is only half as much.

At present there are about 370 horse and 130 hand sprinkling carts. These belong to the city, while the horses are furnished by the contractors at $68 a month, including the pay of the driver. The surfaces watered by the carts are as follows: Paved streets, 5,240,000 sq. yds.; macadam streets, 774,000 sq. yds.; asphalt streets, 310,000 sq. yds.; wood pavements, 209,000 sq. yds.; side alleys of sand, 12,000 sq. yds.; total, 6,555,000 sq. yds.

All the sidewalks of Paris, be they of granite, asphalt or mosaic, are submitted to the same kind of cleaning. Hand work is entirely used, owing to the numerous kiosks, which prevent machine cleaning. In dry weather a simple sweeping with a birch broom is sufficient, this implement having proved the best instrument to clean corners and small spaces. In wet or foggy weather, or during a very light rain, when the sidewalks are apt to become muddy, if the mud be hard it is removed by a scraper, but if soft the usual way is to add more water and rub with the rubber scraper before mentioned.

In the case of the smaller pavements, the washing is done as follows: The mouth of the main is opened, allowing the water to flow down the gutter, from which it is taken in a scoop with a long handle and thrown over the sidewalk. At the same time another workman goes over the pavement with a brush broom and then cleans it off with the rubber scraper. When it rains the scraper alone is sufficient. Paper and other refuse are carefully removed at all times. The cost, according to the budget of 1889, for the maintenance of paved streets amounted to about $956,000 over a surface of about 7,570,000

sq. yds., or 12.7 cts. per sq. yd. This includes both cleaning and repairing.

There were about 1,792,000 sq. yds. of stone pavement, the maintenance of which cost $650,700, or 35.3 cts. per sq. yd., and 534,000 sq. yds. of wooden pavement, calling for 36.2 cts. per sq. yd. for maintenance on the most frequented streets. The cost of keeping the asphalt streets in condition was about 33.3 cts. per sq. yd. With wood pavement it is absolutely necessary to have subways for wires and pipes, as the surface should never be disturbed. The pavement of this kind laid in Paris has given very good results, but great care was used in preparing the Portland concrete foundations and in selecting the wooden blocks.

In dry weather the rules for washing the streets are as follows: On streets paved with stone, about once in 3 days; on macadam, once in 3 days; on asphalt, once in 2 days; on wood, once every day. As a general rule, these washings are performed between 4 and 8 o'clock A. M.

During the day, as soon as the sweeping and washing is over, the refuse is emptied into the drains or carted away. During rainy weather the sweeping is done two or three times, and during the frosty season a second machine sweeping takes place in the afternoon. Each sweeping is followed by a thorough cleaning of the gutters.

The birch broom is the most effective instrument for the latter use. The mains are quite low, almost on a level with the gutter, so that when the water rushes out, the roadman, by means of a piece of rough sackcloth, can form a little dam to direct the current in any direction he pleases.

Another carefully managed and important detail is the sprinkling of sand, more especially on wood and asphalt surfaces. There is no rule for this work, as it depends largely on atmospheric conditions. The roadmen have orders to use sand as often as is necessary, and are accountable for the faithful performance of the work.

The schedule of the day's duties is as follows:

4 to 6:30 A. M.—Brushing and washing of streets and sidewalks; sanding, to insure a good footing for the horses; disinfection and washing of soiled surfaces.

6:30 to 8:30 A. M.—Removal of house refuse.

8:30 to 11 A. M.—Cleaning of street track; washing gutters; watering.

11 A. M. to 1 P. M.—Meal-time of the roadmen. The meal is advanced to 10 or delayed until noon if necessary from atmospheric conditions, and is sometimes reduced to one hour. During extremely hot weather the watering service continues without interruption. The men are then divided into two sections, one working while the other rests.

1 to 4 P. M.—Machine sweeping, if necessary; watering; cleaning; sweeping sidewalks; washing benches.

7 to 9 P. M.—During the five winter months sanding asphalt and wood pavements, which is considered as extra work.

The way in which ice and snow are handled in Paris is very perfect. It is an absolute rule that in time of snow the active workers, whatever be their duties under ordinary circumstances, are to be employed in the snow service. Depots are organized and an intelligent roadman placed at the head of each, and here the supplies of sand and salt are established. All the streets are classed according to the urgency of the work required in them, the main centers of traffic, the principal omnibus and horse-car routes and similar thoroughfares being cleared first.

In broad streets the snow has to be heaped in two banks, and a central way five to seven yards wide is first prepared. In the small, narrow streets with heavy traffic the snow is entirely cleared away, and in unimportant streets a single bank is formed and the snow is left to thaw and melt away.

The best cleaner for light snows is the machine sweeper with steel brushes. In 1880 a sort of plow mounted on runners was introduced. They were triangular in shape, 11½ ft. broad at the rear and with sides diverging at an angle of 50°. The two blades of sheet iron met in an iron point or spur. They were not very successful and the 88 now belonging to the department are rarely used.

Salt was first used on a large scale in Paris in 1880. It is carried about in small carts drawn by three or four men. One man sits in the cart and throws the salt with a large shovel all over the road, where it thaws the snow into a slush which will rarely freeze. Then the rubber scrapers are brought into requisition and the whole is driven down the gutters into the sewers. The means of sprinkling the salt are so far rather primitive, but several new ideas are under discussion.

The snow is disposed of in two ways. One is to dump it into the Seine through special culverts opened during the winter season; and the second, and possibly more general way, is to dump it into the sewers. When the latter method is employed, the sewer tenders are put on special duty to see that no stoppage occurs, and water is freely used to flush the masses along.

During the period of snows the Compagnie Générale des Omnibus is required by its charter to place 52 horse carts at the disposal of the city engineers and to transport at the beginning of winter 4,000 cubic metres of sand to any point designated by the engineers.

When the snow falls during the day, without waiting for the fall to cease there is a general turnout of the roadmen and workmen from the various organized centers before mentioned, equipped with brooms, shovels and scrapers. They immediately begin shoveling the snow back from the streets to the sides and brush off the sidewalks where this work devolves upon the town, as in front of public buildings, vacant lands, bridges and quays. The residents do the same on the part that concerns them, sometimes requiring to be notified to do so. Effort is made to keep up the circulation on the side walks and to keep passage-ways of sufficient size for vehicles. Where the snow is too deep for manual labor the machine sweepers are put to work, and the workmen complete the clearing.

If, finally, the morning brings a surprise in the way of a considerable fall, the plows are taken out, and an attempt made to open zones from 5 to 8 yds. wide. Then the machines follow. If these combined efforts fail, owing to the snow being hardened by traffic over it, the best remedy is found to be in scattering a thick layer of sand, or making use of salt, which will enable the sand to work into the snow.

WORLD'S FAIR NOTES, to Aug. 18, show that Mr. EIFFEL has forwarded plans and a proposition for building a tower at Chicago. Bids have been opened for the Fisheries Building, and the lowest bidder for the iron work was the Keystone Bridge Company, $11,580. Mr. WILLARD A. SMITH has been installed in office as Chief of the Transportation Department.

The foundations of some of the World's Fair buildings need revision, say rumors from Chicago. Other accounts say that the present stoppage of work is due to Chief of Construction BURNHAM assuming all engineering control since the resignation of Chief Engineer GOTTLIEB. This caution would seem natural when the unreliable character of the soil and the heavy wind pressures of Chicago are considered. Meanwhile all the news from Chicago in the direction of alleged blunders is in the form of pure rumor.

The Eiffel tower proposition of M. EIFFEL himself is objected to by American civil engineers. If one is to be built at all they want it to be of American design and construction. A protest signed by 25 well-known engineers of Chicago has been sent in calling attention to plans already proposed by American engineers, and objecting to the acceptance of M. EIFFEL's proposition.

THE RAIN-MAKERS, in their experiments at Midland, Tex., of Aug. 18, claim a decided success. A rain of 6 hours' duration, covering about 1,000 sq. miles, is said to have followed the explosion of the first oxy-hydrogen balloon, the dynamite kites and the detonation of an unknown quantity of powder. At the time of the experiment only a few white clouds floated in a blue sky, with the barometer showing the air as remarkably dry, and pointing to "fair." The barometer commenced to fall in 10 minutes after the explosion of the balloon at the height of 1¼ miles, and clouds began to gather and "a torrent of rain" followed almost at once. No details are presented of the amount of rainfall, and the ranchmen and local weather prophets do not believe the storm was made by the efforts of Gen. DYRENFORTH and his party.

THE MEMPHIS BRIDGE is progressing, and the work is now as follows: The anchorage span and first cantilever arm are erected. The falsework for the central span is now being erected, and will probably be completed about Sept. 1. It is supported on piling driven in 45 to 75 ft. of water, with about a 3-mile current. Grading and timber trestling for the western approach are in good progress.

DESIGNS FOR A BRIDGE across Darling Harbor, Sydney, New South Wales, are invited, and will be received until Jan. 4, 1892, by the Under Secretary of Public Works, Sydney. The bridge will be from the foot of Market St. to Union St., Pyrmont. The author of the first approved design will receive $3,500; of the second, $1,500, and of the third $1,000. The conditions upon which the designs are invited may be obtained from Sir SAUL SAMUEL, Agent General for New South Wales, 9 Victoria St., London, England.

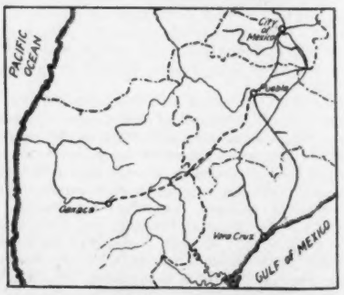
THE METEOROLOGICAL CONGRESS, to open on Aug. 26 at Munich, is the first held for 11 years, and the third in all. Prof. M. W. HARRINGTON, chief of our weather bureau, and Prof. CLEVELAND ABBE, sailed last week, and with them will attend Prof. W. M. DAVIS, of Cambridge; Prof. PICKERING, of Harvard, and Prof. A. L. ROTCH, of Blue Hill Observatory, near Boston. One committee, appointed in 1884, will report at the coming meeting upon methods for obtaining accuracy and uniformity of measurements in all parts of the world.

THE ARAUCO RAILWAY, in Chile, has a gage of 5 ft. 6 ins., and is laid with rails weighing 50 lbs. per yard. The sharpest curve has a radius of 200 m. The locomotives and cars are of English construction. The engines were built by Fowler & Co., of Leeds; Manning, Wardle & Co., of Leeds, and Stephenson & Co., of Newcastle. The cars are on the American plan, and were built by the Lancaster Wagon Co. The Nitrate Railways, near Iquique, Chile, have 230 miles of main line and branches laid with rails weighing 64 lbs. per yard. The locomotives are of the Fairlie double boiler, double truck type, with eight driving wheels, and weigh about 80 to 85 tons each. The steepest grades are 2.5 to 3.85%, and there are curves of 150 ft. radius.

The Mexican Southern Railway.

One of the most important and difficult pieces of railway construction now under way in the Republic of Mexico is that of the Mexican Southern Ry., whose route we show in the accompanying sketch. We abstract the following brief discription from a somewhat cursory article published in the *Mexican Financier:*

The concession for this road was secured by H. RUDSTON READ, of the firm of Read & Campbell, of London, England, the present contractors, in May, 1888, and in May of the following year a company was formed with a capital stock of £1,100,000 to



Map of the Mexican Southern Ry.

build the first 224 kilos. of the line from Puebla to Tecomavaca. The contract for construction was let to Read & Campbell, and work began in September, 1889. The capital necessary to construct the section from Tecomavaca to Oaxaca, 143 kilos., was not secured until 1890. Construction was begun in September of that year. The line was completed from Puebla to Tecomavaca a few weeks ago and will soon be opened for business. On the line from Tecomavaca to Oaxaca, about 35 kilos. of the grading have been finished and will be open for traffic before the close of the present year. The entire line is expected to be completed by September, 1892.

The permanent way of the completed line is above the average for newly constructed lines, in Mex-

ico. All bridges and culverts are of iron or masonry. The roadbed is ballasted throughout, the ballast being 30 cm. deep, boxed up flush with the tops of the cross-ties, and 2¾ m. wide at the top. About two-thirds of the distance is laid with steel cross-ties weighing 60 lbs. each, and on the remainder oak ties are used. The ties are laid 1,370 to the kilometer, or 2,200 to the mile. The rails weigh 50 lbs. to the yard and are secured to the metal ties by steel keys, and to the wood ties with ordinary spikes. Angle splice bars, weighing 25 lbs. per pair, are used. The rolling stock was all constructed in England. The passenger cars are finished on the outside in teak and are picked out with gold letters. The roofs are slightly arched and are covered with white canvas. The passenger locomotives have four 51-in. drivers, coupled; outside cylinders 14 × 24 ins., and four-wheeled bogie trucks. The freight locomotives have six 48 in. drivers, coupled; outside cylinders 16 × 22 ins., and four-wheeled bogie trucks. The total weight of the engines, without fuel or water, is 39 tons for passenger and 43½ tons for freight. For the heavier grades on the last part of the line a heavier type of locomotive will be used, viz., tank locomotives having six drivers, coupled; outside cylinders 16 × 20 ins., and four-wheeled bogie trucks with outside frames. The rigid wheel base will be 7 ft. 1 in., total wheel base 18 ft. 11 ins., and the heating surface 1892.7 sq. ft. All stations and other buildings are of wood or stone and built in a permanent manner.

Owing to the almost inaccessible location of a portion of the line, great difficulty was found in keeping the engineers' and contractors' camps provided with food and other supplies necessary for carrying on the work. The line passes through the narrow and precipitous cañons of the Rio Salado and the Rio San Antonio, and here the most difficult part of the construction has been encountered, the general features being similar to those on the Denver & Rio Grande R. R. through the Marshall Pass in Colorado.

The road traverses a country rich in minerals and containing large areas of fertile land. Only a small proportion of this has as yet been placed under cultivation, and comparatively nothing has been done toward the development of the mineral resources. The traffic derived from the portion now opened for business is better than was expected, and it is thought that there will be a paying business from the beginning.

The main offices and shops of the company are at Puebla. The road is being operated by the contractors, with W. A. ECKERSLEY as manager. The engineers in charge of construction are: D. G. DAVIES, J. E. MCCURDY and T. S. ABBOTT.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Lake Champlain & Moriah.—The two-mile branch of this railway to the Fisher-Hill mines, near Elizabethton, N. Y., has been graded and tracklaying is in progress.

Westerly & Jewett City.—Work is reported begun on this proposed railway from Westerly, R. I., to Jewett City, Conn., 25 miles. Thos. F. Chappell, Rutland, Vt., Chief Engineer.

Fitchburg.—This company will build a branch from near Marlboro, Mass., to the granite paving-stone quarries owned by The Webb Co., a distance of 2 miles.

Boston & Maine.—This company will straighten its line in Durham and Madbury, N. H., shortening the distance between Exeter and Dover, N. H., 3 miles. The work will necessitate considerable new grading and the construction of a new station at Durham.

New York, New Haven & Hartford.—This company expects so have the four-tracking between South Norwalk and Bridgeport, Conn., 12 miles, and also the one-half mile at Port Chester, Conn., completed this fall. Seventy-four-pound rails are being used.

Cleveland, Wooster & Muskingum Valley.—A correspondent writes us that the grading has been completed, and that tracklaying is in progress upon this railway from Wooster to Lodi, O., about 20 miles. The grades and curves are light. Tracklaying will be finished and the road in operation by Oct. 1. Ryan & McDonald, contractors, of Baltimore, Md., are the owners. C. I. Ryan is President.

Little Falls & Dolgeville.—A press dispatch from Dolgeville, N. Y., states that work is not proceeding in a very energetic manner on this railway. Only about 5 miles have been graded thus far, and work is being carried on only by a small force. The company states that work will soon be far enough advanced to call for the 20% assessment on the bonds, and that after this faster progress will be made.

Toledo, Walhonding Valley & Ohio.—Contracts for building this Ohio road were let on Aug. 17 as follows: A. M. Winsper, Tiffin, O., 11 miles; W. F. Stanley, Reedy, W. Va., 16 miles; Matthew Spellacy, Cleveland, O., 11 miles; Jones & Winsper, Mt. Vernon, O., 4 miles; McCann & Elerinor, Steubenville, O., 4 miles; J. F. Meyer, Roscoe, 1 mile of stone-work and grading at Coshocton. The work is to be finished by March 1, 1892. Bridge contracts will be let in a fortnight. The contracts for cross-ties will be awarded Aug. 25. J. A. Hanlon, Canton, Chief Engineer.

Adirondack & St. Lawrence.—The contract for a 6 mile section from Ringville toward Wolf Pond has been let to a Captain Hussey. About 3,000 men are now at work on the line.

Projects and Surveys.

Utica & Unadilla Valley.—Delos E. Culver, of 80 Broadway, New York City, it is stated, has made a proposition to build this proposed railway from Bridgewater to New Berlin, N. Y., 20 miles, on condition that the people along the route grant the right of way free.

Moosilauke.—Chief Engineer F. W. Conn, of Concord N. H., has completed his estimates for the construction of this railway. The road is to run from Warren Station to the summit of Mount Moosilanke, 20 miles. He recommends a friction road for the entire distance, and states that such a line can can be built with a maximum grade of 211 ft. per mile and a maximum curve of 15°. The grading will be light for mountain work, and the road can be built ready for the rolling stock for $400,000. The road will open up a fine timber country and furnish a route to the mountain for summer tourists.

Cincinnati, Union City & Chicago.—A press dispatch says that work on this proposed railway between Union City and Huntington, Ind., 70 miles, will be pushed. Surveys are now in progress between Portland and Union City.

Mahoning & State Line.—This company has been organized at Youngstown, O., to build a railway to limestone quarries and manufactories along the Mahoning River. Work, it is stated, will begin within two months, and the line will be completed ready for the spring traffic.

Tower City & Brookside.—There is talk of organizing a company to build a railway from Tower City to Brookside, Pa. It is estimated that the line will cost about $30,000.

Plymouth & Bourne.—Chas. M. Thompson, of Sandwich, Mass., Chief Engineer, writes us as follows:

This road is projected to run from the terminus of the Old Colony R. R. in the village of Plymouth through the towns of Plymouth and Bourne to the Cape Division of the Old Colony R. R. near the fifty ninth mile post, a distance of 15 4-10 miles. The preliminary and topographical surveys have been completed, and the locating survey will begin at once. The work will be principally sand and gravel, with some boulders; maximum grade 50 ft. per mile; maximum curve 3°. There will be no large bridges, and only 3,000 lin. ft. of trestle. The town of Plymouth has voted $75,000 in aid of the line and private individuals have subscribed about $60,000. The line when completed will probably be controlled and operated by the Old Colony R. R. Under the charter the line may be operated only 7 months of the year providing they be consecutive. Construction will probably not begin before next spring. William A. Nye, Bournedale, Mass., President.

Black River.—This is the name of the proposed railway from Cavendish Station to Springfield, Vt., noted last week under the head of "Springfield." Geo. A. Ayer, Perkinsville, Vt., Chief Engineer.

Lehigh & Eastern.—It is reported that money has been subscribed for a new survey of this road.

Lawrence State Line.—This company has been chartered in Pennsylvania to build a railway 2 miles long in Mahoning township. Jas. M. Bailey, of Pittsburg, is President; John G. Brighton and Geo. H. Kuhn, of Pittsburg, are directors.

SOUTHERN.—Existing Roads.

Georgia, Carolina & Northern.—The bridge across the Oconee River is nearly completed and tracklaying will now be rapidly pushed between Athens and Atlanta, Ga. The bridge is 887 ft. long and 85 ft. high.

Florida Southern.—T. L. Marquis, of Barton, Fla., has the contract for building branches to the United States and Massachusetts Phosphate companies' mines.

Norfolk & Western.—The contract for building 1½ miles of the belt line at Roanoke, Va., has been awarded to Rogers & O'Brien, of Roanoke. The entire line will be 8½ miles long. Chas. S. Churchill is the engineer in charge of work.—A corps of engineers under the direction of the Norfolk & Western R. R. is now making a survey from Colburn, Va., on the Church Valley Division, up Big Tom branch. The object of the survey is to finally locate a line to reach the large coal deposits of the Virginia & Tennessee Coal & Iron Co., which owns immense tracts of land in Wise and adjacent counties. In this connection the feasibility of the Charleston, Cincinnati & Chicago R. R. using the tracks of the N. & W. R. R. from St. Paul to Colburn has been broached. The grading of the former road is about complete to St. Paul. By using the tracks of the N. & W. R. R. the heavy grades of the contemplated line up Lick Creek would be avoided, and a better route would be secured from St. Paul to the water of the Big Sandy.

Kentucky Midland.—Surveys are in progress over the old route between Paris and Sharpsburg via Owingsville. The road has to be completed to North Middleton by January next to secure a county subsidy.

Ohio Valley.—Surveys are in progress for the proposed line from Princeton to Hopkinsville, Ky.

Chesapeake & Ohio.—The branch from Covington to Hot Springs, Va., 25 miles, has been completed. The road was a very difficult one to construct, having a large amount of rock-work. The contractors were Gooch, Rinehard, Carpenter & Co., and work was begun in February, 1891. About 1,200 men and 400 mules were employed.

New Orleans & Northwestern.—It is reported that a settlement has been reached of the difficulties between the Natchez Construction Co. and the stockholders of this company and that work will be resumed at once.

Projects and Surveys.

Western Carolina.—W. J. Kirk, General Manager of the Western Carolina R. R. and the Northern Georgia Ry., with offices at Andersonville, S. C., writes the *Manufacturers' Record* that these companies were each chartered with the same corporators in the fall of 1890, and since then have been fully organized with the same officials. The purpose is to build a first-class railroad from Port Royal to Clayton, Ga., at which point the line will branch—one line by way of Franklin, N. C., to Knoxville, Tenn., and the other through several northern counties of Georgia and thence to Chattanooga, Tenn. Arrangements are now being made to complete the consolidation, making one system to the several points. Active work has not yet commenced, except preliminary surveys over difficult sections and securing rights of way over several divisions.

Atlantic & Pacific.—Chartered in Tennessee to build a railroad from a point on the Knoxville & Augusta R. R., in Knox Co., to the Tennessee River.

Lehigh Valley & Southern Coal, Iron & R. R. Co.—This company proposes to build a railway from Greenville, Tenn., via Newport, Sevierville and Knoxville, Tenn., to Nashville, Tenn., with a branch to Middlesborough Ky. Chief Engineer L. C. Walkins, of Greenville, Tenn., writes as follows to the *Manufacturer's Record*:

We are in hopes to commence construction on or about Sept. 1, and with that purpose in view the syndicates meet in Greenville Aug. 1. The railway will be built in connection with a company in another State, to form a quick, short route between the coal fields of Pennsylvania and the leading cities of the Southwest.

Cedar Key Building & Investment Co.—This company proposes to build a railway from phosphate mines in Alachua and Levy counties, Fla., to the Gulf of Mexico, near Cedar Key.

Brunswick, St. Mary's & Florida.—Chartered in Georgia to build a railway from Brunswick, Ga., to St. Mary's, Ga., a distance of 31 miles. Among the incorporators are: John J. Spears, John A. Foster and Wm. B. Burroughs.

Cumberland Short Line.—Chartered in Georgia to build a railway, 12 miles long, in Camden Co., Ga. The incorporators are the same as for the Brunswick, St. Mary's & Florida R. R. Co.

Georgia.—Bills have been introduced into the Georgia State Legislature incorporating the Atlanta, Americus & Florida Ry. Co., and the Georgia & Western R. R. Co.

Little Kanawha.—At a recent meeting of the directors the following officers were elected: President, C. H. Shattuck; Secretary, E. McCreary; Treasurer, W. A. McCash and General Counsel, V. B. Archer.

Smithsonia, Danielsville & Carnesville.—The following officers have been elected: President, J. F. Colbert; Vice-President, J. F. White, and Secretary and Treasurer, David W. Meadow.

Lower Creek & Linville Valley.—John M. Houck, of Lenoir, N. C., Chief Engineer, writes as follows:

This railway, which is projected to run from Lenoir, N. C., via Collettsville, Houck and Linville to Cranberry Forge, N. C., 50 miles, is the property of the Wilson Lumber Co. Nine miles of the grading have been completed and 3 miles of track laid. About 10 miles of the work will be light, and the remainder quite heavy. There will be one or two bridges. The road is being built to develope the timber and mineral resources, and will do principally a freight business. Geo. E. Stone is President.

Charleston, Clendennin & Southern.—F. W. Abney, of Charleston, W. Va., President, writes that the surveys for this railway will begin soon. It is to run from Charleston, W. Va., up the Elk River, 40 miles. The route is through a farming and mineral region, and the road is projected largely to develop the coal and mineral lands. Right of way is being secured, and $75,000 of private subscriptions and $100,000 from Kanawha Co. obtained. No Chief Engineer has been appointed yet.

Chesterfield & Lancaster.—W. A. Evans, of Hornsboro, S. C., President, writes as follows:

This railway is projected to run from Cheraw, S. C., via Chesterfield, to Lancaster, S. C., a distance of 56 miles. The route is through a quite level country affording easy grades and curves. There will be a bridge over Thomson's Creek. A small amount of the right of way has been secured, and $50,000 in bonds obtained from Chesterfield Co. A Chief Engineer has not been appointed.

Guyandotte River.—Mark M. Pomeroy, 46 Pulitze Building, New York City, informs us that he has on foot

a railway to run from the Ohio River, near Huntington, W. Va., up the Guyandotte Valley to the Norfolk & Western R. R., 120 miles, with two branches, 12 and 18 miles long, respectively. The route is through heavily timbered country, affording light work; maximum grade 30 ft. per mile. There will be one tunnel about 1,200 ft. long. The object of the road is to open up a large tract of mineral land owned by its projectors. It is expected to begin work early the coming season.

NORTHWEST.—Existing Roads.

Superior, Red Wing & Southwestern.—Bids for building 7 miles of this road from Allouez Bay to the Minnesota State line have been opened and the contract will probably be awarded soon. The contract will include the grading, bridging, water tanks and tracklaying, and will amount to $85,000. Contracts will soon be let for the dredging, dock building and construction of terminals at Allouez Bay. Contracts will also be let to build north from Deronda, Wis. Work is to begin at once.

Chicago & New Orleans.—The engineers who have been surveying this line from Paducah, Ky., to Shelbyville, Ill., have completed their work, and a report states that construction will begin within 60 days.

SOUTHWEST.—Existing Roads.

Arkansas Midland.—This company has secured the right of way for a branch from Trenton to Poplar Grove, Ark., and will, it is stated, begin work at an early date.

Kansas City, Nevada & Fort Smith.—Tracklaying has been begun on the extension from Amoret, Mo., to Hume, Mo.

San Antonio & Aransas Pass.—Surveys are reported in progress for a line from Giddings, Tex., via Columbus to Altair or Eagle Lake, Tex., and possibly to the mouth of the Brazos River.

St. Louis & Hannibal.—The St. Louis, Hannibal & Kansas City Ry. Co., has been chartered in Missouri to build a branch of this railway from New London to Perry, Ralls Co., Mo. It is intended to begin work at once. The route of the line will be over an old roadbed partly completed some years ago. The people along the line give $300 per mile, right of way and depot facilities in aid of the enterprise.

Projects and Surveys.

Kansas City, Louisiana & Gulf.—A correspondent writes us as follows:

On account of the present condition of the money market, this company has decided to defer the construction of its proposed line until further developments were favorable to the building of new roads. Nothing has been done beyond the preliminaries necessary in such undertakings.

Sherman & Northwestern.—W. A. Thomas, of Wichita, Kan., President, writes us as follows:

This road is projected to run from Sherman, Tex., north to the Kansas State line, 300 miles. The work will be light. There will be a bridge across the Red River 1,000 ft. long. The principal business of the road will be in timber, coal, grain and cattle.

South Galveston & Gulf Shore.—Lucian Minor, of Galveston, Tex., Treasurer, writes us as follows:

This road is projected to run from Galveston to South Galveston, Tex., 20 miles. The preliminary survey has been completed for 8 miles. The route is through a level country affording very easy grades. The road will do a passenger business principally. M. F. Mott is President. No Chief Engineer has been appointed.

ROCKY MT. AND PACIFIC.—Existing Roads.

Northern Pacific.—Twenty-four miles of the grading have been completed on the South Bend Branch and 7 miles of track are laid. About 600 men are now at work.

Great Northern.—About 25 miles of track remain to be laid on the Seattle and Montana R. R., and it is expected to have the road in operation by Oct. 15.

British Columbia.—A press despatch from Victoria B. C., says:

The City Council last night decided to submit to the people by-laws appropriating nearly $3,000,000 for railway subsidies. One million is to the Victoria & North American Ry., represented by Paul Schultz, and said to be part of the Northern Pacific Co. Another proposition is to connect with the Canadian Pacific at New Westminster, and with American roads at Blaine. The latter is from Victoria, Slanich & New Westminster, and asks for a loan of $500,000 for 25 years and a subsidy of $20,000 annually for the same time.

Great Salt Lake & Hot Springs.—At a meeting of the directors held Aug. 3, it was decided to extend this railway from its present terminus at Beek's Hot Springs to Centerville, Davis Co., Utah, a distance of 8½ miles. The work will cost about $58,000. Varley Bros. have the contract for the first mile. H. S. Joseph, Chief Engineer, Salt Lake City.

Projects and Surveys.

Portland Southern Ry. Co.—This company has been chartered in Oregon. The objects of the company are: The buying, building, establishing and maintaining of all ways and means of transportation and communication both by land and water, and the producing and dealing in light and power. The principal offices are at Portland, and among the incorporators are W. S. Mason, C. C. Clark, T. Sperling, John L. Ayer, M. Meyer.

Truckee & Lake Tahoe.—A project is on foot to build a railway from Truckee, Cal., to Lake Tahoe. 15 miles. The line has been surveyed, and is estimated to cost $200,000.

San Joaquin Valley.—A. T. Baron, of Alameda, Cal., Chief Engineer, writes as follows:

This road is projected to run from Fresno, Cal., via Hamptonville into the timber lands, 70 miles. There will be about 20 miles of valley work, 12 miles of rolling hills, and the remainder mountain work. There will be one 900-ft. bridge. About 25 miles of the right of way has been secured, and $100,000 obtained from the city of Fresno. Fifty-two miles have been located, and surveys are in progress. The contract has been let to Fitzgerald Bros., who have 10 miles graded ready for the rails. About 120 men and 30 teams are now at work. The company was chartered in March, 1891.

FOREIGN.

Nicaragua.—A press dispatch says:

There is a prospect of a new railway from the western shore of Lake Managua over the mountains of Matagalpa and Segovia to the headwaters of the Grand River, on the Mosquito coast. A rich Kansas syndicate, through its representative, Mr. Strong, has made a proposition to the government for the construction of this railway, and it is probable that the proposition will be accepted. The syndicate is to receive 1,750,000 acres of public lands. The proposed railway will meet with few obstacles, and will traverse one of the most productive regions of the globe.

CITY TRANSIT.

Electric Railways.—New lines or extensions of existing systems are reported as probable at the following places: Mt. Airy, N. C., address the Granite City Land & Improvement Co.; Middletown, O.; Berkeley, Cal., address the Oakland & Berkeley Rapid Transit Co.; Meadville, Pa.; Lockport, Pa.; Beverly, Mass., address the Haumkeag Street R. R. Co.; Cheyenne, Wyo.; McKeesport, Pa.; Lancaster, O., address A. Bauman; Matteawan, N. Y.; Blaine, Wash.

Somerville, Mass.—It is probable that the West End Ry. of Boston will be extended over a number of streets in this town. The matter is still under discussion, but the need of better transit facilities is very great and arrangements for new lines will probably be made.

Rochester, N. Y.—It is reported that the directors of the proposed road from Rochester to Fairport have concluded to extend their line from Cobb's Hill through Pittsford to Fairport. Right of way is now being secured.

Jamestown, N. Y.—It is reported that the Jamestown Electric Ry. may be extended from Lakewood to Chautauqua, a distance of 12 miles.

Staten Island, N. Y.—The New York *Times* states that that the Staten Island electric light plant having been destroyed by fire, Erastus Wiman proposes to put up a big electrical station, capable of affording from 6,000 to 10,000 HP. From this plant not only would the electric lights be furnished, but also the motive power for the electric roads now proposed, and power for sale for commercial purposes. The proposed new trolley roads would take the old belt line as a basis. That road runs from Fort Wadsworth over the hills to Port Richmond, but is a slow and circuitous route. It failed some time ago and is now in the control of some Brooklyn creditors, who are said to favor the electric system. As yet the routes to the interior have not been determined, but one would run back from Port Richmond to Prohibition Park and beyond, another would open up the Silver Lake region, and another be built on the old Manor Road.

Newport News, Va.—Surveys for the line to Old Point have been completed, and it is expected that work will soon begin.

Atlanta, Ga.—J. H. Mountain, H. L. and E. B. Woodward have applied to the legislature for a charter to build a line from this place to Manchester, electricity will probably be the motive power.

Montgomery, Ala.—The Montgomery Terminal & Street Ry. Co. has applied for permission to use electricity on its street railway. The improvements are estimated to cost $80,000.

The City & Suburban Street Ry. Co. has made a preliminary contract, through A. W. Le Bron, with New York parties for building its lines, and has petitioned the city council for an extension of time in which to begin work.

Kankakee, Ill.—The Enterprise Electric Light & Ry. Co. has been granted a franchise to use Schuyler Ave. for a trolley road. Work will begin at once.

Madison, Wis.—The street railway has been sold to the Thomson-Houston Electric Co., of Chicago, by C. B Holmes, the former proprietor. The road has recently been quite successful. The new owners intend to introduce electric machinery, and extend the line.

Racine, Wis.—The Belle City Street Ry. has been sold to the Holmes' syndicate of St. Louis. C. and G. B. Hathaway, the principal owners, are reported to have received between $75,000 and $90,000. The old rails will be taken up and a heavy standard gage track constructed which will be adapted to the electrical system to be adopted.

Galveston, Tex.—Engineers are surveying a line for the South Galveston & Gulf Shore R. R., from Galveston to South Galveston, a distance of about 20 miles. The city council has been petitioned for right of way on a number of streets.

Pomona, Cal.—The San Antonio Power & Electric Light Co., with a capital stock of $240,000, has secured from the Pomona Land & Water Co. the right to the waters flowing from the San Antonio cañon for the purpose of generating electricity for motive power, electric lights, etc. They bind themselves to have in operation within a year an electric road from a point near the Pomona depot to Claremont.

Anacortes, Wash.—The city has granted the Anacortes & Skagit Motor Ry. Co. a franchise for 25 years from Jan. 1, 1892, for a system of lines. City Engineer Ira C. Otis writes us that the scheme also includes a 10-mile freight and passenger line to the Swinimish flats and Olympia marsh, two very rich agricultural districts. C. R. Donnell, M. S. Cody and F. W. Spear are interested.

Horse Railways are reported as probable at Quitman, Ga., address the Quitman Street Ry. Co., and Knoxville, Tenn., address Samuel McKinney.

North Danville, Va.—Lea & Co., of Danville, have received the contract for grading and constructing the North Danville Street Ry., to be about two miles long. It is intended to have cars running in 60 days.

Macon, Ga.—A bill has been introduced in the legislature incorporating the Transvale Ry. Co., to build street railways and bridges. Incorporators, G. B. Turpin, J. W. Cabaniss, A. O. Bacon; capital stock, $100,000.

Green Cove Springs, Fla.—C. C. Bemiss, W. J. Wilson, S. F. Hanford and others have chartered the Green Cove Springs Street Ry. Co., recently reported as to build a line here.

Laramie, Wyo.—A 10-year franchise has been granted a company here. Eight miles of road must be in operation within a year.

Cable Railway.—***San Francisco, Cal.***—The Presidio & Ferries R. R. Co. is reported as contemplating an extension of the line costing $250 000, and the stockholders will be asked on Sept. 10 to vote for an issue of bonds to that amount.

Dummy Railway.—***Salt Lake City, Utah.***—The West Side Rapid Transit Co. has received $175,000 to extend its line along Great Salt Lake to Crescent Beach. There is some talk of introducing electricity.

New Companies.—Twenty-third Ave., Piedmont & Alameda Ry. Co., Alameda, Cal.; capital stock, $100,000; directors, D. T. Hoskins and F. H. Ross, of San Jose; H. T. Ross, of Santa Rosa, and others. Hagerstown Street Ry. Co., Hagerstown, Md.; capital stock, $100,000; incorporators, J. D. Main, R. M. Keedy, S. M. Schindel and others. Kanawha City & Charleston R. R. Co., Kanawha City, W. Va.; capital stock, $50,000; incorporators, A. C. Hall, A. D. McCorkle, J. H. Morgan and others. Bonham Rapid Transit Ry. Co., Bonham, Tex.; capital stock, $25,000; J. W. Russell, President. Buffalo & Williamsville Electric Ry. Co., Williamsville, N. Y.; capital stock, $50,000. Middletown Electric Street Ry. Co., Middletown, O.; capital stock, $100,000. Citizens' Passenger Ry. Co., Mt. Pleasant, Pa.; capital stock $18,000; incorporators, D. S. Jordon, W. D. Mullin, R. H. Goodman and others. Southover Street R. R. Co., Savannah, Ga.; capital stock, $15,000; incorporators, Col. C. H. Olmstead, J. L. Whateley, C. H. Dousett. Norfolk Street Ry. Construction Co., Norfolk, Va.; capital stock, $25,000; incorporators, H. O. Whyman, C. A. Mast, J. G. Hamilton and others. Roland Ave. Electric Ry. Co., Baltimore, Md.; capitol stock, $25,000; incorporators, A. H. Rutherford, D. H. Thomas, R. J. Capron.

HIGHWAYS.

Connecticut.—An improved driving road to the Pequot district is projected at New London.

New Jersey.—The Board of Freeholders at New Brunswick is considering a scheme for extending the macadamized roads into the country districts, thus giving Middlesex Co. such a system of roads as has already been secured in Union Co.

Tennessee.—At Morristown it is proposed to issue bonds for the improvement of the county roads. Convict labor is being employed on the roads near Memphis.

Georgia.—The Bibb Co. committee of road commissioners and county commissioners, appointed to investigate the working of road systems in other counties, has reported in favor of putting the management of the county roads under one superintendent, under the supervision of the county commissioners. In Richmond Co. the judge of the County Court is ex-officio commissioner of roads, and the work is done by convict labor.

Oregon.—The principal roads of Multnomah Co. are being improved by cutting the trees and bush and removing stumps for the entire width, and laying gravel.

Washington.—The Whatcom Co. commissioners are considering a proposition to bond the county for $50,000 for road work. The Clallam Co. commissioners at Port Angeles, have awarded contracts for a road for which the county has issued $100,000 in bonds. The contract has been let to E. C. Burlingame at $17.85 per mile for the western division of 42 miles, $95,000 for the middle division of 38 miles (including bridges), and $20,000 for the eastern division of 17 miles.

BRIDGES, TUNNELS AND CANALS.

Bridges.—***Galveston, Tex.***—The County Commissioners' Court will receive plans, specifications, estimates and bids until Sept. 14 for building a bridge connecting Galveston Island with the main land. The bridge will cost about $500,000.

Victor, Cal.—Bids will be received until Sept. 7 for building a combination or iron bridge, two spans, 270 ft. and 40 ft. respectively, with 3 masonry piers, or one iron

span 310 ft. Geo. L. Hisom, Clerk, San Bernardino Co., Cal.

Canals.—The Suwanee Canal Co. has been organized in Georgia to drain the Okefenokee swamp.

WATER-WORKS.

NEW ENGLAND.

Madison, Me.—It is reported that works will be built by the Madison Water Co., including a 500,000-gall. reservoir or stand-pipe and 25 hydrants.

East Epping, N. H.—Works are projected.

Kingston, Mass.—Aug. 24 a meeting will be held to consider water-works improvements.

West Stockbridge, Mass.—It is reported that the company will extend a main across the river to supply Albany St.

Winchendon, Mass.—Works are talked of again.

Newport, R. I.—The company has received permission to extend its mains into the town of Middletown.

Woonsocket, R. I.—The aldermen have passed an ordinance in concurrence providing for the purchase of new pumping machinery. The Water Commissioners will receive bids until Aug. 27 for laying mains to and in Manville.

New Britain, Conn.—It is expected that the building of a new dam will soon be started.

MIDDLE.

Brooklyn, N. Y.—A new 42-in. force main broke Aug. 14. It is reported that a piece of iron 7 ft. long, and at its widest point 3 ft. wide, was torn from the pipe.

Buffalo, N. Y.—The contract for a 20,000,000-gall. pumping engine has been awarded to the Holly Manufacturing Co., Lockport, N. Y., for $92,250. The only other bid was from the Lake Erie Engineering Works, Buffalo, about $78,000. The Commissioners state that the lowest bidders did not comply with the specifications, and that the engine proposed by them is experimental.

Carthage, N. Y.—Moffett, Hodgkins & Clarke estimate the cost of works, including 6 miles of mains and about one mile of rock trenching, at $54,000.

Rome, N. Y.—Bids are wanted until Sept. 1 for $160,000 3½% 20-year refunding bonds.

Sandy Creek, N. Y.—The people have voted to build works. Proposed supply, brook, 205 ft. above Main St.

Troy, N. Y.—Prices are wanted on 3,000 to 5,000 ft. of 8-in. pipe.

Walton, N. Y.—It is reported that the Walton Water-Works Co.'s application for a franchise has been granted, the terms being the same as those of the present company's franchise. Supply, Howland's East Brook Pond.

Plainfield, N. J.—The Plainfield Water Supply Co. has requested permission to extend its mains to supply North Plainfield Borough.

Madison, N. J.—It is proposed to issue additional water and light bonds to the amount of $15,000.

Blossburg, Pa.—Works are projected.

Mansfield, Pa.—A franchise is to be granted to L. A. Waters and L. Amerman, Scranton. There will be 40 hydrants.

Monroeton, Pa.—The works referred to last week as nearly completed here is the new supply main for Tonawanda. The Tonawanda company may introduce a supply from this main, but the borough has not decided to take water.

Stroudsburg, Pa.—The vote on building $40,000 works will be taken on Aug. 22.

SOUTHERN.

Florence, S. C.—The election to vote on the issuance of $22,000 water and sewer bonds, to have been taken Aug. 11, was postponed. E. W. Lloyd is City Clerk.

Buena Vista, Ga.—Authority to build works is being sought.

Gainesville, Fla.—Aug. 15 the people voted 136 to 12 to bond the city for works.

Lake Charles, La.—The Lake Charles Ice, Light and Water-Works Co. has been incorporated; capital, $100,000.

Greenville, Tenn.—H. Reaves informs us that a franchise can be obtained by a good company.

Lawrenceburg, Tenn.—It is reported that works will be built by J. W. Garrett.

Harrodsbury, Ky.—Sept. 19 the people vote on granting a franchise to J. A. Geary and J. M. Roche, Lexington. Seventy-five hydrants are proposed at $50 each per year.

Mayfield, Ky.—We are informed that the Mayfield Construction Co. wishes bids for 10 to 4-in. mains, and laying same, valves, lead and a stand pipe.

NORTH CENTRAL.

Lorain, O.—Bids for a 2,000,000-gall. pump and an addition to the pump house will be received by the Trustees until Aug. 30. C. H. Washburton is President.

Youngstown, O.—J. D. Cook, Toledo, has reported on improvements including a new supply from impounding reservoirs on Mill Creek and a stand-pipe. Estimated cost, $300,000.

Butler, Ind.—The people have voted to put in works.

Elwood, Ind.—We are informed that the Elwood Water Co., will begin construction of works about Sept. 1.

Blissfield, Mich.—It is stated that works will be built for the east side of the town.

Buchanan, Mich.—F. A. Treat, Village Clerk, informs us that a contract for a water power dam across the St. Joseph River has been let to E. R. Beardsley, Waldron, Ill., and that bids are wanted for water-works material.

Marcellus, Mich.—J. J. Nash informs us that the village talks of building works, with a supply pumped from wells to a stand-pipe; cost $6,000. An election will probably be held soon to decide the matter.

Beardstown, Ill.—H. M. Schmoldt, Mayor, informs us that the people have just voted for works and that a hydraulic engineer is wanted. Population, 5,000.

Litchfield, Ill.—The Litchfield Water Supply Co. has been incorporated; capital, $15,000.

Brodhead, Wis.—We are informed that complete works are talked of. The village has an artesian well with a slight flow and has put in a few rods of 6 and 8-in. pipe for fire protection.

NORTHWESTERN.

Detroit City, Minn.—E. D. Holmes informs us that the people have voted for works, and that contract will let Aug. 24.

Broken Bow, Neb.—The project for the purchase of the company's works by the town has been voted down.

South Sioux City, Neb.—C. D. Smiley informs us that this and an adjoining town could be supplied from one system. Population, 2,500 each. The people wish works, but no action has been taken.

Great Falls, Mont.—It is reported that the company proposes to extend its mains, and erect a 18 × 50-ft. stand pipe.

SOUTHWESTERN.

St. Louis, Mo.—Bids will be received by the Board of Public Improvements until Sept. 4 for about 2,500 tons 6 to 36-in. cast-iron pipe, 100 tons specials, 250 fire plugs, and 188 6 to 20-in. stop valves; also for hauling, trenching for and laying 75,500 ft. 6-in., 45,500 ft. 8-in., 20,000 ft. 12-in. pipe, and setting 200 fire plugs. E. S. Foster, Secretary.

Tarkio, Mo.—We are informed that material for works will be bought at once, including about 3 miles of 4 to 8-in. cast-iron mains and a stand-pipe. Address Water Co.

Ballinger, Tex.—A contract for works has just been let to Drennen & Lee, Waco, for $14,500.

Corpus Christi, Tex.—Jaeger & McMullen have made a proposition to build works which seems likely to be accepted.

Brighton, Col.—The Brighton Water and Electric Light Co. has been incorporated; capital, $20,000.

PACIFIC.

Tacoma, Wash.—A Citizens' Water Commission of 11 members has been appointed to investigate water-works. Nelson Bennett and W. J. Thompson are on the commission.

Dallas, Ore.—Bids are wanted until Sept. for lining reservoir, 31,500 sq. ft., and receiving basin, 10 350 sq. ft., with asphaltum. C. L. Phillips, Secretary Water Commissioners.

Dixon, Cal.—The Dixon Light & Water Co. has been incorporated; capital, $60,000.

Susanville, Wash.—It is reported that a 22-in. main, 4 miles long, will be laid.

Provo, Utah.—J. E. Rhodes, Denver, Col., is trying to secure a contract to build works for the city.

CANADA.

Essex, Ont.—The contract for works has been awarded to William Garson, St. Catherines.

ARTESIAN WELLS.

Gainesville, Fla.—A well is proposed for water works supply.

Jacksonville, Fla.—John Clark and others talk of sinking a well to supply the Carleton Hotel and Mohawk block.

Mascoutah, Ill.—Another attempt will be made to secure artesian water.

Fairbury, Ill.—A well is proposed as a source of supply for water-works. Address R. C. Straight.

Pana, Ill.—The Council has voted to sink a well 2,000 ft., or deeper, for a general water supply.

Bloomington, S. Dak.—There is talk of a well for Darlington township.

Mitchell, S. Dak.—It is reported that another well will be sunk.

Rawlins, Wyo.—A well, 10 ins. in diameter at the bottom, will be sunk.

Helena, Mont.—For some time a project to sink a well in the Prickley Pear Valley has been on foot, and subscriptions have been secured. Land Commissioner Lambour, of the Northern Pacific Ry. Co., has offered the company guaranteeing to sink a well a section of land at $1 per acre. It is thought that a well will be sunk.

IRRIGATION.

Sheridan County, Wyo.—The North Wyoming Canal Co. has applied to State Engineer Elwood Meade for permission to take water from Tongue River and its tributaries to irrigate 50,000 acres.

Bakersfield, Cal.—Works to irrigate about 150,000 acres of land with water from Kern River are projected by capitalists, and the people in the same locality are talking of organizing an irrigation district.

Butte County, Cal.—A canal through the western part of the country is projected. It would tap Feather River about two miles below Oreville.

Calico and Daggett, Cal.—E. S. Hubbard and A. G Mappe, San Bernardino, are interested in a scheme to develop water from the Mojave River for mining and irrigating purposes. The Silver Valley Land & Water Co. are the projectors.

Elsinore, Cal.—The Elsinore Irrigation district has voted $450,000 for acquiring water and laying pipe. It is stated that water will be bought from the Bear Valley Irrigation Co.

Escondido and San Marcos, Cal.—A large irrigation project, said to be backed by Moffett, Hodgins & Clarke Syracuse, N. Y., is reported.

Visalia, Cal.—A vote will be taken soon on the organization of an irrigation district, taking water from Tule River.

Vreka, Cal.—An irrigation district is projected to be watered from the the Klamath River.

New Companies.—Minatare Canal & Irrigating Co. Minatare, Neb.; $20,000. Water Supply & Storage Co. Fort Collins, Col.; $60,000; to operate in Weld, Grand and Larimer Cos. Santa Fé Land & Canal Co., Lamar, Col.; $100,000; to operate in Bent and Powers Cos. Carr Canal & Irrigation Co., Linkville, Ore.; $60,000; J. D. Carr, I. W. Smith. La Canyada Water Co., La Canyada, Cal.; $36,000, of which $3,600 has been paid up. Directors, Thomas Pickens, La Canyada; F. D. Lauterman, Los Angeles, and others.

SEWERAGE AND MUNICIPAL.

Sewers.—***Massachusetts.***—Boston. The Metropolitan Sewerage Commissioners have awarded the contracts for sections 15 and 17 to C. McBride, and for section 16 to R. A. Malone & Son. The prices of bids were given last week. Proposals for 3 more sections will be opened Sept. 5.—Nantucket. A sewerage system is projected.

Connecticut.—Burnside. Sewers are projected.—Meriden. The plans prepared by Mr. McKenzie, of Southington, all for sewers 30, 36 and 40. ins. diameter, and the cost will be about $130,000.

New Jersey.—Plainfield. The Mayor is said to have refused to sign a contract granted by a section of the Council to J. M. Lowe, of the Plainfield Sewerage Co., owing to the general public objection to the contract.—Washington. The plan of forming a stock company to build sewers has been abandoned.

Virginia.—Roanoke. The plan suggested in the report by Mr. Rudolph Hering has been adopted.

Alabama.—Birmingham. The City Engineer has been directed to prepare plans and specifications for about 13 miles of sewers for the South side.

Ohio.—Findlay. The sewer outfit contract has been awarded to the Boughen Engineering Co., of Cincinnati, O., at $17,921.—Salem. A sewerage system is projected.

Indiana.—Vincennes. A sewerage system is to be built. The plans will be prepared by Mr. E. F. Fuller, of New York.

Missouri.—Springfield. The sewer contract has been awarded to K. R. Bemiss & Co., of Joliet, Ill., for $158,123.

Colorado.—Trinidad. Mr. N. W. Wall is making surveys and plans for a system of sewers for the old portion of the city, and the work will take several months.

Washington.—Seattle. Mr. Benezette Williams, of Chicago, has presented to the Board of Public Works his plans and report for the sewerage system.

Arizona.—Phœnix. A sewerage franchise has been granted to Frank Baxter and J. L. B. Alexander.

California.—Stockton. The Board of Public Works has adopted plans and advertised for bids for main sewers. The contract for pumping station has already been let.

Streets.—***Rhode Island.***—Pawtucket. An appropriation of $25,600 has been made for sidewalks.

Pennsylvania.—Reading. The city proposes to collect a tax from the street railway company for paving.—Lancaster. Three streets are to be paved with fire brick, Belgian blocks or asphalt blocks.

Virginia.—Danville. Lea & Co., of Danville, were the lowest bidders for 17,000 sq. yds. of granite block paving and the bid was recommended for acceptance.

Kentucky.—Covington. The Warren-Scharf Asphalt Paving Co. has a contract for about $300,000 of work.

Michigan.—Detroit. The Board of Public Works approves of cedar block paving, and estimates that repairing will cost $500,000 per year.

Colorado.—Denver. Macadam paving is to be laid on Eighteenth Ave.

Bonds.—Columbus, Ga.; $200,000 for sewers and public improvements. Menominee, Mich.; $95,000 for sewerage and paving, bought by Harris & Co., New York. Florence, Ala.; $22,000 for waterworks and sewerage. West Duluth, Minn.; $115,000.

ELECTRICAL.

Electric Light.—New plants or extensions of existing systems are reported as probable at the following places; Detroit, Mich.; Birmingham, Ala., address the Como City Land Co.; Dallas, Tex., address the Mayor; Franklin, W Va., address W. W. Moore; Wheeling, W. Va., address W. E. Whitaker; Alexandria, Va., address F. M. Welch; Attleboro, Mass.; Stephenville, Tex., address W. C. Baldwin; New Martinsville, W. Va.; Charleston, W. Va., address the Board of Public Works; Huntsville, Tex., address W. S. Gibbs; Salinas City, Cal., address the National

Electric Development Co.; Tolono, Ill., address S. Stocking; Aurora, O.; Carthage, Ill.; Napanee, Ind.; Elberton Ga.; Mayfield, Cal.; Muncy, Pa.; Belle Fourche, S. D. Sarcoxie, Mo.; Mascoutah, Ill., address E. R. Pagist; Tioga, Pa.; Ithaca, Mich.; Cambridge, O.; Leslie, Mich.

Leesburg, Va.—Sealed proposals for electric street lighting will be received until Aug. 29 by Mayor H. O. Clagett.

Augusta, Ga.—The Lamp Committee will receive bids until Sept. 1 for erecting a plant of sufficient capacity to light the city.

Columbus, O.—A press dispatch gives the following statement of the operating expenses of the municipal station at Columbus: The total cost of operating was $575 for the quarter embracing May, June and July. Sixty-eight lights were furnished, the average cost being $8.50 a quarter or $34 a year. Previous to the introduction of the municipal plant, the city paid a private company $3,520 a year for 48 lights, or $73.33 per light.

Marshall, Ind.—The Western Electric Co., of Chicago, has been awarded a contract to furnish this city with thirty 2,000 c. p. lights for 10 years at $75 each a year.

Vallejo, Cal.—The city has signed a street lighting contract by the terms of which it will be supplied with 90 lights of 2,000 c. p. at $5.90 each a month.

New Companies.—Grand Haven Electric Light & Power Co., Grand Haven Mich.; capital stock, $10,000. Hughesville Electric Light & Power Co., Hughesville, Pa.; capital stock, $10,000; G. S. Moyer, Treasurer. Wagner Electric Light Co., St. Louis, Mo.; capital stock $25,000; incorporators, H. A. Wagner, G. E. Claflin, E. G. Ellis and others. Radford Water, Light & Power Co., Radford, Va.; capital stock, $1,000,000; incorporators, J. J. Doran, F. J. Kimball, J. H. Dingee. Poland & Minot Water, Electric Light & Power Co. Mechanics Falls, Me.; capital stock, $25,000; incorporators, E. E. True, N. D. Pope, J. M. Libby. Dixon Light & Heat Co., Dixon, Cal.; capital stock, $60,000. Kensey-Wright Electric Elevator Co., Denver, Col.; capital stock, $25,000. Brighton Water & Electric Light Co., Brighton, Col.; capital stock, $20,000; incorporators, W. H. Malone, W. C. Kidder, J. McKeon. Citizens' Fuel, Light & Power Co., Celina, Cal.; capital stock, $50.000; incorporators, A. F. Marsh, S. S. Scranton, T. P. Touvelle and others.

CONTRACTING.

Dredging.—*New York, N. Y.*—The Dock Commissioners have awarded a contract to the Morris & Cumings Dredging Co. at 20 cts. per cu. yd. for 134,800 cu. yds.

Boston, Mass.—Proposals for dredging in Chatham harbor have been received by Col. S. M. Mansfield, U. S. Engineer Office: C. W. Anthony, Fall River, Mass., 41 cts. per cu. yd., scow measure; G. Runyon, Boston, 40 cts. for dredging, and $8 per cu. yd. for boulders weighing over 3 tons.

Brick.—*Cumberland, Md.*—The contract for firebrick has been awarded to the Fairhope Mount Savage Fire Brick Co. at $12 per 1,000 delivered.

Washington, D. C.—The District Commissioners have awarded the contract to the Washington Brick Machine Co.; 3,500,000 paving brick, $8.93 per 1,000 in the city, $9.43 in Georgetown, $11.93 in the county, and $8 at company's yard for use in the county; 300,000 sewer brick, $7.23 per 1,000 in the city, $7.73 in Georgetown, $9.23 in the county; hand made pressed paving bricks, packed in hay or straw, $15.97 per 1,000.

Piles.—*Norfolk, Va.*—The Bureau of Yards and Docks, Washington, D. C., has received the following proposals for furnishing and driving yellow pine piles to carry the tracks for the 40-ton traveling crane at the Norfolk navy yard: Ross & Sanford, Baltimore, Md., $6.50 per pile, $4,992; H. E. Culpepper, Portsmouth, Va., $7.25, $5,660; Cofrode & Evans, Philadelphia, Pa., $7.50, $5,760; Charles Bliven, Berkley, Va., $8.25, $6,400.

Street Work.—*Omaha, Neb.*—A contract for sheet asphalt paving has been awarded to Fox & Drexel at $2.70 per sq. yd.

Birmingham, Ala.—The contract for Belgian block paving has been awarded to Venables Bros., of Atlanta, Ga., at $2.65 per sq. yd.

Michigan City, Ind.—Contracts for cedar block paving have been awarded to Ohming & Schneider, at 86½ and 88½ cts. per sq. yd. Bids ranged as high as 90¾ cts.

Detroit, Mich.—The cost of paving per sq. yd. is about as follows: Cedar block on plank, $1.76; asphalt, $2.93; asphalt repaving, $2.63; brick, $2.65; silica-barytic stone, $2.76; cobblestone, $1.06.

Sewers.—*Washington, D. C.*—The District Commissioners have received the following proposals for 2,225 ft. of 18-in. pipe, 1,650 ft. of 21-in. pipe, and 4,270 ft. of 24-in.: G. R. McCann, $1.50, $1.75 and $1.95 per ft.; E. E. Barnes, $1.27, $1.69 and $1.89 per ft.; P. Brennan, $1.55, $1.75 and $2.50; J. McCandlish, $1.35, $1.65 and $1.95.

Stone.—*Lawrence, Mass.*—The contract for paving blocks has been awarded to Lahey & O'Donnell at $64 per 1,000. Moulton & O'Mahoney bid $66.

Boston, Mass.—B. F. May & Co. bid $3.53 per lin. ft. for 431 ft. of granite curbing on Maverick Square, East Boston.

PROPOSALS OPEN.

Sewers.—*Hammond, Ind.*—About 4,000 ft. of brick and 10,000 ft. of tile. W. F. Bridge, City Engineer. Aug. 24.

Willimantic, Conn.—Trenching and laying 1,500 ft. of 6-in. and 2,000 ft. of 8-in. vitrified pipe; 13 manholes. W. G. Smith, Engineer. The Sewer Committee. Aug. 28.

Terre Haute, Ind.—Ohio St. sewer system and laterals, brick and pipe, with manholes and catch basins. A. C. Duddleston, City Clerk. Sept. 1.

Street Work.—*Terre Haute, Ind.*—Grading, gravel roadways 36 ft. wide; sidewalks, 12 and 14 ft., with 7 and 8 ft. paved with cinders or gravel screenings: wooden curb. A. C. Duddleston, City Clerk. Sept. 1.

West Bay City, Mich.—Paving with cedar blocks 6 ins. long, on board foundation in 3-in. drain tile; cobblestone gutters 5 ft. wide, stone curb. The Board of Public Works, Aug. 27.

Dayton, O.—Sidewalks of flagging, cement or asphalt. C. A. Herrig, City Auditor. Aug. 28.

Bridges.—Plans, specifications, strain sheets and proposals for bridge across the Salinas river near San Lucas, and across the Arroyo Seco river; with shore protection. T. J. Riordan, County Clerk, Salinas City, Monterey Co., Cal., Sept. 7.

Plymouth, Mass.—Length, 2,200 ft.; oak pile bents hard pine floor, 24 ft. wide, 24 ft. draw. E. S. Shaw, 146 Franklin St., Boston, Engineer. The County Commissioners. Sept. 1.

Wharf.—*Tompkinsville, N. Y.*—Removing old wharf, building new wharf and dredging the basin at lighthouse depot. Also ironwork for wharf. Major D. P. Heap, U. S. Lighthouse Engineer. Aug. 25.

Steel Plates and Rubber Washers.—Armor plates for war ships; rubber washers for armor bolts. The Secretary of the Navy, Washington, D. C. Sept. 1.

Shears.—Constructing and erecting a pair of 100-ton shear legs at the Boston navy yard. The Bureau of Yards and Docks, Navy Department, Washington, D. C. Sept. 1.

Lining Reservoir.—*The Dalles, Ore.*—Liping with asphaltum the reservoir, 31,500 sq. ft., and receiving basin, 10,250 sq. ft., of the water-works. C. L. Phillips, Secretary. Sept. 4.

Water Works Plant and Street.—*Cincinnati, O.*—Engine, coal crushers, etc., at Front St., pumping station. Also vitrified brick paving. The Board of Administration. Sept 1 and 17.

Retaining Wall.—*Brookline, Mass.*—About 700 cu. yds. A. H. French, Town Hall. Aug. 31.

Pipe Lines.—*Toledo, O.*—Furnishing and laying cast iron, wrought iron or steel pipe, with screw or lead joints; 12,000 ft. of 10-in., 35,000 ft. of 6-in., 128,000 ft. of 4-in., 51,000 ft. of 3-in., 2,000 ft. of 2-in. Natural Gas Trustees. Aug. 26.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Lima Machine Works, of Lima, O., manufacturers of the Shay patent geared locomotive, report recent shipments of 16 Shay engines, from 10 to 50 tons weight, and 75 logging and flat cars; also orders on hand for 11 Shay engines and 140 cars. The New York Locomotive Works, of Rome, N. Y., have delivered 4 passenger engines to the San Antonio & Aransas Pass; the company has increased its capital stock $400,000. The Brooks Locomotive Works, of Dunkirk, N. Y., have built 4 freight engines for the Jacksonville Southeastern, and are at work on 12 engines for the Great Northern and 20 ten-wheel engines, with cylinders 17 × 24 ins., for the Lake Shore & Michigan Southern; 118 engines have been built during the past 6 months. The Baldwin Locomotive Works, of Philadelphia, Pa., have an order for 10 consolidation engines, including one compound, for the Western New York & Pennsylvania.

Cars.—The Erie Car Co., of Erie, Pa., has an order for 300 freight cars for the Pennsylvania southwest lines; the Ohio Falls Car Co., of Jeffersonville, Ind., and the Terre Haute Car Co., of Terre Haute, Ind., for 200 each, and the Peninsular Car Co., of Detroit, Mich., and the Missouri Car & Foundry Co., of St. Louis, Mo., for 150 each for the same lines. The Wason Car Co., of Springfield, Mass., has built some passenger cars for the Central Vermont. The American Car Co. has been organized at St. Paul, Minn., by W. Rutton, E. Alexander and T. Papin, Jr.; $100,000.

Car Works.—A company proposes to purchase the property of the Columbia Steel Car Co., at Desplaines, Ill., and manufacture steel cars. The Pullman Car Co. will extend its Chicago and St. Louis works. The Lafayette Car Mfg. Co., of Lafayette, Ind., has purchased a site for new works near Crown Point, Ind., on the Calumet River.

The Industrial Works, of Bay City, Mich., have the contract for the entire equipment of traveling cranes for the new plant of the Grant Locomotive Works at Chicago, consisting of 4 cranes with a capacity of 40, 20, 12 and 10 tons. Each will have an extended span, possess the latest features in crane construction, and be operated in all of its parts by electricity. Crane work is being made a specialty. Among recent shipments have been a steel transfer crane of 30 tons capacity for the Rio Grande Western, a shop crane for the western terminal of the Northern Pacific, and heavy station cranes for the Philadelphia & Reading and Cincinnati, Hamilton & Dayton railways. In process of construction are a complete wrecking outfit for the East Tennessee, Virginia & Georgia; a self-propelling powerful steam yard crane for the Solvay Process Co., of Syracuse, N. Y., with several accompanying steel cars; 2 shop cranes for the G. A. Gray Co., of Cincinnati, O., and several 20-ton cranes of different types for the Pittsburg & Western, Southern Pacific, and Chicago, Rock Island & Pacific roads. The company is erecting a 70-ft. electric transfer table of special design for the Wagner Palace Car Co., at Buffalo, N. Y., and has finished a similar table, operated by steam, for the St. Thomas shops of the Michigan Central.

The Berlin Bridge Co., of East Berlin, Conn., has the contract for the buildings for the new electric light plant for the Pawtucket Gas Co., at Pawtucket, R. I. The dynamo room will be 60 × 150 ft., the engine room 58 × 78 ft., and the boiler room 60 × 80 ft. The side walls will be of brick with iron roof covered with corrugated iron. Plans and specifications were prepared by Remington & Henthorn, Engineers and Architects, Providence, R. I.

H. Ward Leonard & Co. is the title of a company recently incorporated in New Jersey. Mr. H. Ward Leonard was formerly general manager of the light, power and intelligence departments of the Edison General Electric Co., and among his associates will be A. St. C. Vance, E. H. Harrison, C. H. Bloomer and August Manning. The company will not manufacture or act as selling agents of any concern, directly or indirectly, but will act for the purchaser, either as consulting or supervising engineers, inspectors or purchasing agents. The charges, estimated on the contract price, for such work are as follows: Preliminary plans and estimates, 1%; final plans and specifications, 1%; drawing and executing contracts, 1%; supervising installation of another contractor, 3%; inspecting work of another contractor, 1%; acting as purchaser's agent with another contractor, 1%; acting as purchaser's agent from beginning to final settlement of contract, including preparations of plans and specifications, inspection, etc., 5%. The specialty of the company is the transmission of power and the application of electric motors to elevators, pumps, hoists, mine tramways, etc. The company will also maintain an intelligence department, costing $25 or $50 a year to the subscribers, according as they require simply electrical or general engineering and electrical information. The subscribers thus avoid all charges for consulting engineers.

The Lidgerwood Mfg. Co., of New York, states that 13 of the new type heavy hoisting engines recently placed upon the market have been sold within a year. A testimonial from the Vermont Marble Co., of Proctor, Vt., states that the 2-drum hoisting engine runs 2 derricks, hoisting 20-ton blocks 152 ft. in 1¼ mins., with a steam pressure of about 60 lbs., 300 ft. away from the engine.

Companies.—Extensible Car Step Co., of Kalamazoo, Mich.; $100,000. Sheriden Metal Wheel Co., of Perrysburg, O.; $75,000. Steel Barbed Fence Ribbon Co., of Valverde, Col.: $250,000. Duluth Mfg. Co., of Duluth, Minn. (successor to the Minnesota Iron Car Co.); O. H. Simonds, of Duluth; C. W. McLellan, of New York; Gen. S. L. Woodford, of Brooklyn, N. Y.; $1,250,000. Western Steam & Street Ry. Equipment Co., of Chicago, Ill.; J. S. Methof, L. M. Tracy, C. T. Faren and B. B. Watson; $100,000. Mills Improved Pneumatic Brake Co., of Chicago, Ill.; W. B. Mills and O. A. Bogue; $600,000. Lorain Steel Co., of Kittery, Me. Central Car Repair & Mfg. Co., of Chicago, Ill.; $625,000.

Metal Market Prices.—*Rails.*—New York: $30.75 to $31; old rails, $21.50 for iron and $17 for steel. Pittsburg: $30; old rails, $23 to $23.50 for iron and $17.50 to $18 for steel. Chicago: $31.50 to $32; old rails, $23 to $23.25 for iron and $14 to $16 for steel.

Track Materials.—New York: steel angle bars, 1.7 to to 1.8 cts.; spikes, 2.15 to 2.25 cts.; track bolts, 2.7 to 2.8 cts. Pittsburg: splice bars, 1.75 to 1.85 cts. for iron or steel; iron or steel spikes, 2.15 cts.; iron track bolts, 2.75 cts. with square and 2.85 cts. with hexagon nuts. Chicago: splice bars, 1.85 to 1.9 cts. for iron, 2 cts. for steel; spikes, 2.2 to 2.25 cts.; track bolts, 2.7 cts. with hexagon nuts.

Foundry Pig Iron.—New York: $14 to $18. Pittsburg: $14.50 to $16.50. Chicago: $14.50 to $16.

Pipe.—Cast iron, $25 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 52½ and 42½ per cent. on black and galvanized butt-welded; 62½ and 50 per cent. on black and galvanized lap-welded. Casing 55 per cent.

Lead.—New York: 4.45 to 4.5 cts. Chicago: 4.35 cts. St. Louis: 4.2 to 4.22½ cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.95 to 2.1 cts.; tees, 2.45 to 2.75 cts.; sheared iron plates, 1.95 to 2.25 cts.; steel plates, 1.95 to 2.15 cts. for tank, 2.3 to 2.6 cts. for shell, 2.5 to 2.7 cts for flange, 3.75 to 4.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2 cts.; tees, 2.6 cts.; universal iron mill plates, 2.05 cts.; sheared steel bridge plates, 2.15 to 2.20 cts.; refined bars, 1.8 to 1.85 cts.; steel plates, 2.1 cts. for tank, 2.35 cts. for shell, 2.55 cts. for flange, 3.9 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.1 to 2.2 cts.; tees, 2.6 to 2.7 cts.; universal plates, 2.15 to 2.2 cts.; sheared plates, 2.25 to 2.35 cts. for iron; steel plates, 2.4 to 2.6 cts. for tank, 2.85 to 3 cts. for shell, 3 to 3.25 cts. for flange; 4.5 to 5.5 cts. for firebox; boiler rivets, 4.35 cts.